



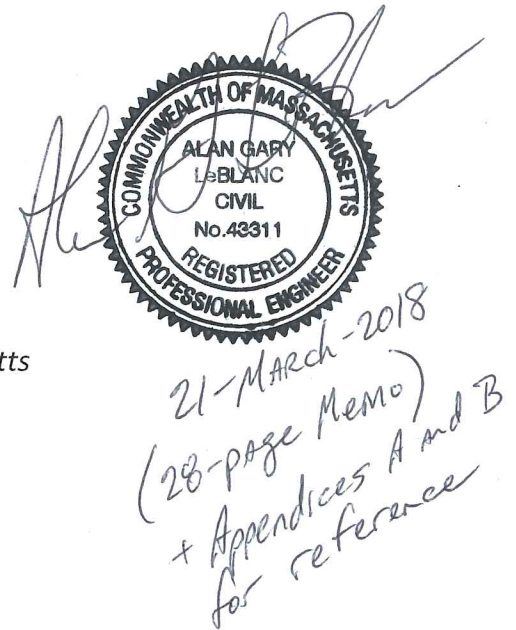
Memorandum

To: Mr. Mark Wetzel, P.E. – Town of Ayer, Massachusetts

From: Ji Im, E.I.T. and Alan G. LeBlanc, P.E., BCEE

Date: March 21, 2018

Subject: Preliminary Treatment Study Memorandum
PFOA and PFOS in Groundwater Supply



The purpose of this memorandum is to summarize the findings of the Preliminary Treatment Study for removing per- and polyfluoroalkyl substances (PFASs) detected at Wells No. 6, 7 and 8 of the Grove Pond Water Treatment Plant (WTP). The scope of this study included analysis of the water quality along with relevant existing information, research on regulatory topics and potential treatment technologies, and reporting on a recommended treatment facility including the corresponding schedule for its design and construction, and conceptual level engineering opinion of probable project cost.

1.0 Introduction

Wells No. 6, 7 and 8 comprise the Grove Pond Wellfield in Ayer. Water from these wells is presently conveyed in a common raw water pipeline and treated in a water treatment plant to remove iron and manganese. The Town of Ayer (Town) observed the combined perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS) concentration in groundwater supply well No. 8 to be above the EPA Health Advisory level of 70 parts per trillion (ppt). This memorandum serves to document and evaluate the Town's options and aid in the future planning.

While granular activated carbon (GAC) is often identified as the preferred treatment technology for PFASs, GAC's capacity to remove the compounds can be exhausted in a relatively short amount of time compared to many contaminants typically treated by GAC. The time to reach contaminant breakthrough varies depending on site-specific conditions such as other constituents in the water source that may compete with PFASs for sorption to the GAC. In addition, smaller chain and less hydrophobic PFASs (which are receiving increased regulatory and public attention) are removed less effectively by GAC than PFOA and PFOS. Long-chain refers to perfluoroalkyl carboxylic acids (e.g. PFOA) with eight or more carbons and perfluoroalkane sulfonates (e.g. PFOS) with six or more carbons. All PFASs with less numbers of carbons are referred to as short-chain. As such, bench-scale testing to evaluate PFAS treatment using GAC will be discussed in this memorandum. Further, other treatment technologies have also been shown to remove these compounds with comparable or potentially improved effectiveness, depending on source water quality, and will be considered as treatment alternatives in this study. The memorandum provides discussion and recommendations

for Ayer's consideration in moving forward with testing, final design, and construction of a PFAS solution. The study discussion is organized into the following sections:

1. Introduction
2. Existing Operations
3. Water Quality
4. Regulatory Review and Treatment Goals
5. Treatment Technologies
6. Bench-Scale Testing Recommendations
7. Preliminary Design Criteria
8. Opinion of Probable Project Cost
9. MassDEP Permitting
10. Project Schedule
11. Additional Topics for Design
12. Recommendations

2.0 Existing Operations

2.1 Grove Pond WTP

The Town meets its system demands with two groundwater well treatment facilities, the Spectacle Pond WTP and the Grove Pond WTP. The Grove Pond WTP is located off Barnum Road near the southern border of Ayer, adjacent to the Massachusetts National Guard Reserve Forces Training Area (RFTA), and the Devens Regional Enterprise Zone, formerly Fort Devens. The Grove Pond WTP treats water from three (3) wells, Wells No. 6, 7, and 8. The water from the three wells is combined in the well house where the water is conveyed to the 12-inch diameter ductile iron (DI) transmission pipe and enters the Grove Pond WTP in an 8-inch diameter pipe.

The raw water is primarily treated through chemical addition and filtration at the WTP. Raw water is dosed first with sodium hypochlorite to oxidize iron and arsenic and then dosed with potassium permanganate to oxidize the manganese and any remaining soluble iron and arsenic, prior to greensand filtration. Six (6) greensand filtration units filter out the oxidized precipitates and have a combined capacity of 1.5 million gallons per day (mgd) with an individual filter capacity of 170 gallons per minute (gpm) per filter. Prior to entering the distribution system, filtered water is injected with additional chlorine for disinfection residual and potassium hydroxide for pH

adjustment. Finished water leaves the plant in an 12-inch diameter DI pipe and then enters the Town's distribution system in the 12-inch diameter water main.

Regarding backwash operation, the filters are backwashed individually with finished water at a rate of 8 to 10 gpm/sf for a 15-minute backwash cycle, followed by a 5-minute rinse. The frequency of backwashing is dictated by run times. The backwash water is directed to one (1) holding tank with three (3) chambers behind the plant and is discharged into the Town's sewer system. Each precast concrete tank has dimensions of 10 feet (ft) by 18 ft by 16 ft with a volumetric capacity of 2,880 cubic feet (ft³) or 21,500 gallons.

2.1 Well Capacity and Operation

Wells No. 6, 7, and 8 are located approximately 800 ft northwest of the Grove Pond WTP. The Town performed major well upgrades in 2014 as Wells No. 6 and 7 replaced old Wells No. 1 and 2, and a new Well No. 8 was completed, formerly named as Well No. 3. Table 1 summarizes the details on the three wells including the capacity and volume approved by MassDEP. The three wells have an estimated combined yield of 2.7 mgd, and their approved combined maximum daily flow is 2.0 mgd. The MassDEP permit indicating the approved pumping volumes is attached as Appendix A.

Table 1. Wells No. 6, 7, and 8 Information

Parameter	Well 6	Well 7	Well 8
Pump	Goulds 10 RJLC, 3 stages		
Capacity	785 gpm @ 349' Total Dynamic Head (TDH)	710 gpm @ 349' TDH	600 gpm @ 349' TDH
Motor	100 Horsepower Centri Pro Motor, 460-volt, 3 phase		
Total Depth (ft -Below Ground Surface)	57	74	73
Approved Maximum Pumping Volume (mgd)	1.00	0.89	0.86
Approved Combined Maximum Flow (mgd)	2 mgd		

The well production data from January 1, 2016 through November 30, 2017 were provided by the Town and plotted in **Figure 1**. The production average for 2016, which had a full year's worth of data available, was 0.86 mgd while the 95th percentile value was 1.38 mgd. Throughout 2016 and 2017, the Town typically operated all three wells to supply the WTP. The overall pumped volume from Well No. 8 has decreased over the past two years. Water from Well No. 8 made up 44% of the total production in 2016 while this contribution decreased to 29% in 2017. The wells typically were operated in a lead-lag-lag/lag sequence, alternating the lead wells. As a result of the PFAS contamination, the wells were set so that Well No. 8 would only operate when Wells No. 6 and 7 were pumping. Without Well No. 8 the Town reports that it would not be able to meet the water demand, especially from the top industrial water users.

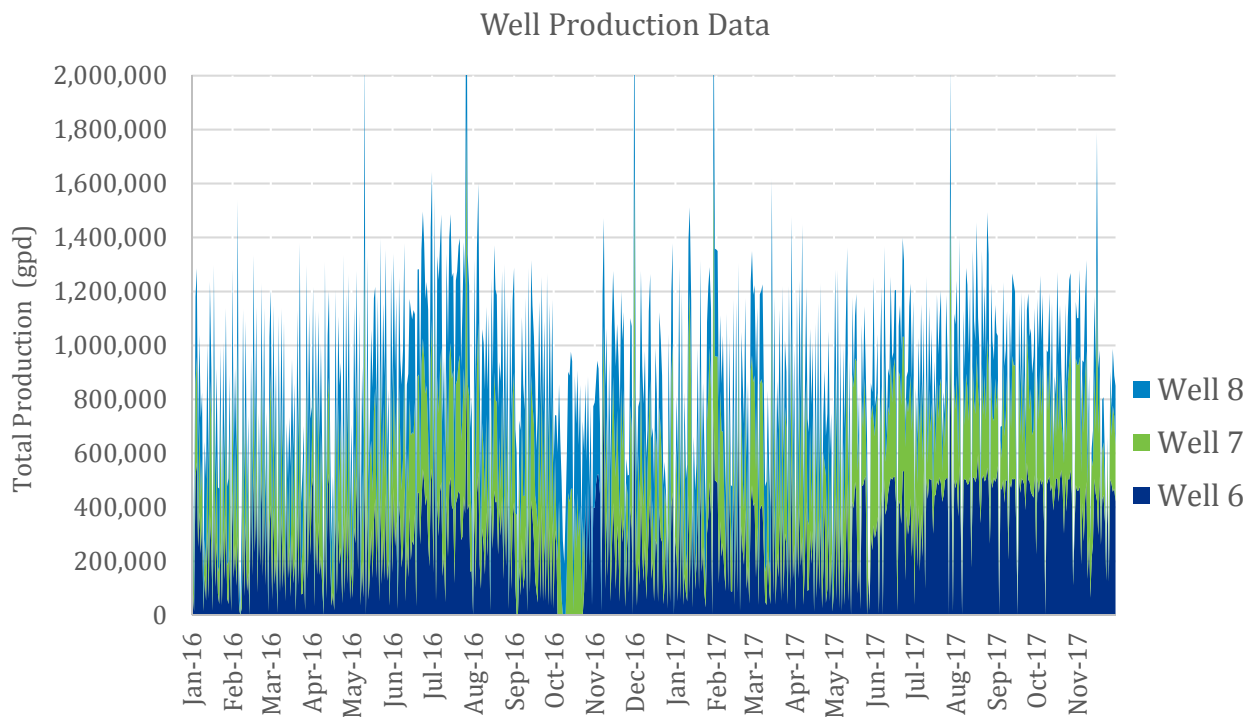


Figure 1. Wells Production Data (1/1/2016-11/30/2017)

3.0 Water Quality

3.1 PFAS

CDM Smith reviewed Town-furnished records as well as additional water analytical data gathered by the Town on December 20, 2017 and January 11, 2018 for PFAS and general water quality parameters. The Town provided the data that had been collected since November 15, 2016 for the six (6) PFASs monitored under the Third Unregulated Contaminant Monitoring Rule (UCMR 3). These six PFASs are listed below, including their chemical names and carbon chain acronyms.

1. Perfluorooctanesulfonic acid (**PFOS**, also known as **C8**)
2. Perfluorooctanoic acid (**PFOA**, also known as **C8**)
3. Perfluorononanoic acid (**PFNA**, also known as **C9**)
4. Perfluorohexanesulfonic acid (**PFHxS**, also known as **C6**)
5. Perfluoroheptanoic acid (**PFHpA**, also known as **C7**)
6. Perfluorobutanesulfonic acid (**PFBS**, also known as **C4**)

The available PFAS data are plotted in **Figure 2**, which indicate that the highest PFAS levels are present at Well No. 8, followed by Well No. 7 and Well No. 6. Overall, the PFAS levels remained steady at Well No. 6 over time while a slight increase was observed at Wells No. 7 and 8. It should be noted that the very last PFAS sample was analyzed by a different laboratory than the rest of the earlier data. Therefore, the slight drop in PFAS levels from December 2017 may be influenced by the difference in analytical methods between the two laboratories. Overall, the combined PFOA and PFOS concentration remained below the Health Advisory level of 70 ppt in the finished water. The combined concentration of all six UCMR PFAS ranged between 66 and 98 ppt.

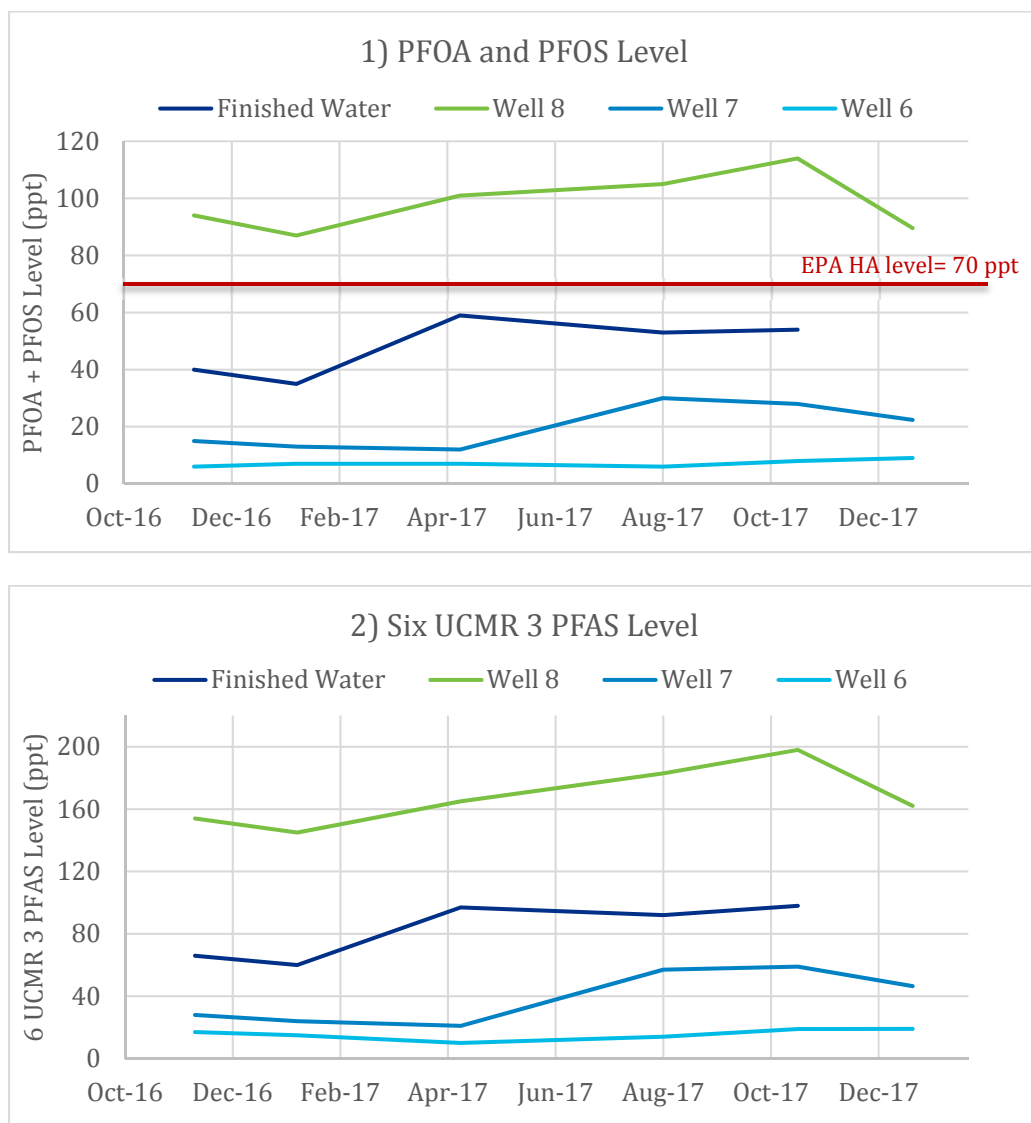


Figure 2. PFAS levels from November 2016 to January 2018
1) PFOA and PFOS only (top) and 2) all six UCMR 3 PFAS (bottom)

Figure 3 presents the average values of each of the six UCMR 3 PFAS compounds for the three wells and finished water. PFOA and PFOS data are shown with a pattern fill to best visually demonstrate their values against the EPA HA level for their combined concentration. Overall, analysis on water from all three wells detected PFOS, PFOA, PFHX, and PFHPA while PFNA and PFBS were not detected. PFOS makes up the largest portion of the detected PFAS at Well No. 8 as well as in the finished water.

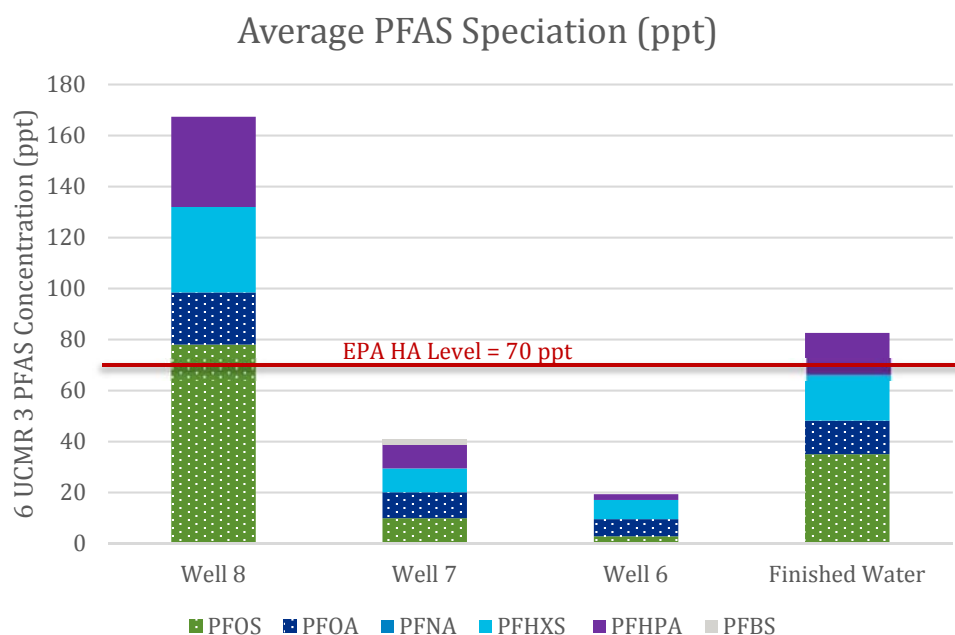


Figure 3. Average PFAS speciation data from November 2016 to January 2018

The Town's historical PFAS data were collected from the three source water wells and finished water and analyzed for the six UCMR 3 compounds only. Thus, data collected prior to this study, do not indicate if other PFASs, particularly other perfluorinated compounds not currently on the UCMR3, were present in the raw groundwater. Due to the possibility that monitoring and treatment of these other perfluorinated compounds will be required, assessment of their presence and potential treatment approaches should be considered (discussed in Section 4). Finally, while oxidation (via the chlorine and permanganate pre-treatment) did not result in any substantial increase in the 6 PFASs monitored in the raw and finished waters, it is currently unknown if compounds other than the 6 monitored PFASs might have been generated via this oxidation due to the potential presence of precursors in the source water.

To assess the wider ranges of PFASs present in the water, the Town sampled the post-greensand filtered effluent with oxidant residuals as well as the three raw water samples on January 11, 2018 for analysis of 24 PFASs, which includes some of the known precursors to the perfluorinated alkyl acids (e.g., PFOA and PFOS). The filtered effluent of the blended water with oxidant residuals prior

to additional chlorine and potassium hydroxide dosing, rather than finished water, was sampled to investigate as it is more representative of the water quality that the PFAS treatment process would treat and thus is needed for planning purposes of bench-scale testing and design criteria.

The 24-compound analysis detected nine (9) PFAS. Five (5) of these, shaded in green in **Table 2**, are the compounds that have been detected in UCMR samples. Four (4) new PFASs were detected: perfluorobutanoic acid (PFBA), perfluoropentanoic acid (PFPeA), perfluorohexanoic acid (PFHxA), and perfluoropentanesulfonic acid (PFPeS). The associated lab report is appended as Appendix B. All these newly detected compounds have perfluorinated chain lengths that are shorter than PFOA and PFOS. Treatment of these shorter-chained compounds is discussed in Section 4.

Table 2. PFAS Detects from 24-Compound Analysis (January 11, 2018). Concentrations shown are in ppt.

PFAS (ppt)	Acronym	CAS	Carbon Chain Length	Filter Effluent	Well 6	Well 7	Well 8
Perfluorobutanesulfonic Acid	PFBS	375-73-5	4	2.11	ND	2.03	3.13
Perfluorohexanesulfonic Acid	PFHxS	355-46-4	6	11.0	5.75	8.18	29.3
Perfluoroheptanoic Acid	PFHpA	375-85-9	7	12.1	2.34	13.9	40.1
Perfluorooctanoic Acid	PFOA	335-67-1	8	9.96	6.22	10.0	20.6
Perfluorooctanesulfonic Acid	PFOS	1763-23-1	8	19.2	2.83	12.4	69.0
Perfluorobutanoic Acid	PFBA	375-22-4	4	11.1	3.72	12.2	29.5
Perfluoropentanoic Acid	PFPeA	2706-90-3	5	29.5	4.1	36.3	98.4
Perfluoropentanesulfonic Acid	PFPeS	2706-91-4	5	ND	ND	ND	2.07
Perfluorohexanoic Acid	PFHxA	307-24-4	6	21.6	3.9	23.8	71.7
Total PFAS (ppt)				117	29	119	364

3.2 Other Water Quality Parameters

For assessing non-fluorine containing compounds and general water quality parameters, CDM Smith reviewed the Town's 2016 and 2017 records of the raw water from the three wells and the finished water. Data are summarized in **Table 3**. Raw water at Wells No. 6 and 7 consists of high iron concentrations (up to 8.2 mg/L at Well No. 6), but the existing greensand filtration achieves substantial iron removal to 0.01 mg/L on average, which is far below the secondary MCL of 0.3 mg/L. Similarly, greensand filtration is also achieving substantial removal of manganese and arsenic.

The Town currently does not sample or analyze the filter effluent for reporting purposes. However, CDM Smith requested the Town to take a sample from the filter effluent and analyze for several parameters, primarily focusing on the organic levels missing from the existing data and the oxidant residuals. These data are presented in **Table 4**, which indicated very low organic levels in the groundwater.

Table 3. General Source Water and Finished Water Quality

Parameter	Well 6			Well 7			Well 8			Finished Water		
	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum
PFOA + PFOS, ppt	6	7	9	12	20	30	87	98	114	35	48	59
Six UCMR 3 PFAS, ppt	10	16	19	21	39	59	145	168	198	60	83	98
24 PFAS Compounds, ppt	29			119			364			N/A		

Parameter	Well 6			Well 7			Well 8			Finished Water		
	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum
pH	6.4	6.6	6.7	6.4	6.6	6.7	6.5	6.65	6.8	N/A		
Alkalinity, mg/L as CaCO3	73	76	78	70	72	73	55	62	69	70	85	95
Hardness, mg/L	103	113	122	97	104	110	125	135	144	106	114	125
Calcium, mg/L	35	38	41	33	35	37	42	45	49	36	38	42
Magnesium, mg/L	4.1	4.5	4.8	3.7	4	4.3	4.8	5.2	5.6	4.1	4.4	4.9
Turbidity, NTU	4.1	6.8	9.5	2.8	12	21	ND			ND	0.11	0.23
Chlorides, mg/L	126	128	130	99	103	107	93	96	98	113	117	122
Color (apparent color units)	18	29	40	80	90	100	ND	0	0	ND	0	0
Iron (total), mg/L	6.4	7.3	8.2	3.00	3.66	4.92	0.01	<0.01	ND	ND	0.011	0.035
Manganese (total), mg/L	1.4	1.9	2.2	2.0	2.2	2.6	0.4	0.5	0.6	ND	0.007	0.015
Total Dissolved Solids, mg/L	302	321	340	248	265	282	284	299	314	290	318	348
Arsenic, mg/L	0.04	0.05	0.07	0.05	0.07	0.08	0.009	0.012	0.013	ND	0.0005	0.002
Barium, mg/L	0.044			0.024			0.021			N/A		
Copper, mg/L	0.004	0.02	0.036	0.017	0.051	0.085	0.011	0.033	0.054	0.018	0.043	0.086
Nitrate, mg/L	ND	<0.06	0.06	0.2	0.22	0.24	0.76	0.84	0.91	0	0.3	0
Nickel, mg/L	0.004			0.002			0.003			N/A		
Potassium, mg/L	3.9	4.35	4.8	3.0	3.4	3.8	3.5	3.9	4.3	13	23	31
Silver, mg/L	N/A			N/A			N/A			ND	0.001	0.006
Sodium, mg/L	62.2			48.8			36.2			7.7	9.3	12
Sulfate, mg/L	5.7	5.8	5.9	5.2	6.0	6.8	13	14	15	N/A		
Zinc, mg/L	0.005	0.08	0.15	0.012	0.096	0.18	0.005	0.07	0.14	0.003	0.008	0.011

Note: In the raw water samples, the following parameters were reported as non-detect: aluminum, antimony, beryllium, cadmium, cyanide, fluoride, mercury, odor, perchlorate, selenium, silver, thallium, and all volatile organic compounds (VOC).
In finished water samples, aluminum and color were reported as non-detect.

Table 4. Filtered Water Quality

Parameter	Filtered Effluent	Sample Date
SUVA, L/mg-m	4.69	1/12/2018
UV-254, cm ⁻¹	0.023	1/12/2018
Dissolved Organic Carbon, mg/L	0.49	1/12/2018
Total Organic Carbon, mg/L	0.436	1/12/2018
Total Chlorine, mg/L	0.13	1/26/2018
Free Chlorine, mg/L	0.09	1/26/2018

4.0 Regulatory Review and Treatment Goals

4.1 Regulatory Review

Since PFASs became emerging contaminants of concern in the early 2000s, federal and state authorities have established a number of health-based regulatory values or advisory levels. On the federal level, final regulations have not been promulgated for PFASs. However, a number of federal laws may apply, including the Safe Drinking Water Act (SDWA). The U.S. Environmental Protection Agency (EPA) issued Provisional Health Advisory (HA) levels in 2009 for short-term exposure at 400 ppt for PFOA and 200 ppt for PFOS, which were later replaced by the updated lifetime drinking water HA of 70 ppt for the combined concentration of PFOA and PFOS. This HA level was “based on the best available peer-reviewed studies of the effects of PFOA and PFOS on laboratory animals (rats and mice) and were also informed by epidemiological studies of human populations that have been exposed to PFASs.” [1]

Presently, there are no regulatory limits for levels in drinking water established by MassDEP.* However, many states within and outside of New England have been actively addressing PFAS contamination and have developed standards and guidance values in drinking water and groundwater. Presently, twelve (12) states have their own standards, health advisories, and/or guidance levels for PFAS in drinking water and/or groundwater, regulated by different authorities.

Many states have adopted the EPA HA of 70 ppt for PFOA and PFOS to use them as advisory, non-regulated levels while several states, including New Hampshire, adopted them as enforceable groundwater standards for PFOA and PFOS. In New Hampshire, the ambient groundwater quality standards (AGQS) of 70 ppt for PFOA and PFOS are enforceable for purposes of site remediation requirements and sources of public water systems [2]. Other states, such as Maine, Iowa, and Delaware, have also adopted the HA in different forms. In Maine’s case, 70 ppt of PFOA and PFOS was adopted as the maximum exposure guideline (MEG) in drinking water by the Maine Center for Disease Control and Prevention (CDC). [3]

Footnote: *Since this memorandum was drafted, an update from MassDEP was provided to confirm that MassDEP is considering adopting recommendations to address five of the UCMR 3 PFAS chemicals discussed in this memorandum and expecting to adopt formal recommendations in the spring of 2018.

Several states have published health-based values based on their own analysis of the available data, resulting in more stringent levels that are either lower than 70 ppt for PFOA and PFOS or involve a broader range of PFASs. Health-based values were developed separately for PFOA and PFOS in Minnesota, 35 ppt and 27 ppt respectively [6]. In the case of another New England state, Vermont, an even more stringent HA of 20 ppt for the sum of PFOA and PFOS was derived in 2016. Additionally, New Jersey is the only state that has established formal maximum contaminant levels (MCLs) for any of the UCMR 3 PFASs. New Jersey's health-based MCLs for chronic drinking water exposure are 13 ppt for PFNA [4], a nine-carbon-chain compound, and 14 ppt for PFOA [5] while a standard for PFOS is currently being developed by NJ DEP.

It should be noted that PFASs in surface water have also been an emerging concern. Currently, Michigan is the only state that regulates certain PFASs not only in groundwater, but also surface water. Michigan's enforceable Human Noncancer Value is set at 11 ppt for PFOS in surface water [8], lower than all the state regulatory levels for a single PFAS compound.

All the state-specific regulations and guidelines that involve various concentration limits demonstrate that in the absence of national regulatory standards, the future of PFAS standards is unclear in all states, especially states like Massachusetts with no current enforceable limits. Connecticut Department of Public Health (DPH) set out an action level of 70 ppt for groundwater in 2016 to regulate not only PFOA and PFOS, but also three additional PFASs (PFNA, PFHxS, and PFHpA). These five compounds are all the UCMR 3's compounds except PFBS, the shortest chain PFAS on the UCMR 3's list. The concerns over the long-chain PFASs, such as PFOA, PFOS, and PFNA, compared to the short-chain compounds that are less biologically persistent and toxic, are similar across the state borders. MassDEP is reportedly developing state standards that may be similar to Connecticut's precedent.

In addition to reviewing regulatory requirements, it is recommended that water providers gain an understanding of their community's potential concerns. PFAS contamination in groundwater has been a widely reported topic by news media in New England and has been painted as a public health crisis in some cases. Public concerns and environmental activist organizations have played an active role during the process of addressing the PFAS contamination and have demanded incredibly low treatment goals and rapid implementation of treatment systems.

4.2 Treatment Goals

CDM Smith recommends that future PFAS treatment by the Town addresses a broader range of PFAS than simply PFOA and PFOS. The following treatment goals were developed in **Table 5**.

- The five PFASs to be included in the combined treatment goal were PFOA, PFOS, PFNA, PFHxS, and PFHpA, the same subset of PFASs regulated by Connecticut DPH and likely to be regulated by MassDEP.
- The total combined concentration of 35 ppt for the five PFASs, was selected for a treatment goal. It is half the concentration of the 70 ppt, the EPA's HA level and Connecticut DPH's

action level and provides the necessary safety buffer for compliance if the MassDEP's regulation is set at 70 ppt.

- The individual treatment goals for PFOA, PFOS, and PFNA were developed based on the most stringent current state regulations from New Jersey for PFOA and PFNA and Michigan for PFOS.
- These treatment goals take into account potential analytical challenges with measuring very low PFAS concentrations.
- In addition, the ability to treat the broader suite of PFASs has benefits for long-term treatment performance and future regulatory updates on PFASs. Subsequent chlorination of the water can oxidize fluorine-containing compounds, known as precursors, that can form longer-chain PFASs like PFOA and PFOS.

Table 5. Recommended PFAS Treatment Goals

PFAS	Acronym	Carbon Chain Length	Individual Treatment Goal	Combined Treatment Goal
Perfluorooctanoic Acid	PFOA	8	14 ppt	35 ppt
Perfluorooctanesulfonic Acid	PFOS	8	11 ppt	
Perfluorononanoic Acid (PFNA)	PFNA	9	13 ppt	
Perfluorohexanesulfonic Acid	PFHxS	6	N/A	
Perfluoroheptanoic Acid	PFHpA	7	N/A	

5.0 Treatment Technologies

Because of the stability of the C-F bonds present in perfluorinated alkyl acids such as PFOA and PFOS, they are not amenable to many conventional destructive treatment technologies. However, several technologies have been investigated for the effectiveness of PFAS removal, and these include granular activated carbon (GAC), anion exchange (AIX), membranes, and higher energy oxidation processes.

5.1 GAC

GAC is the most common treatment method in both drinking water and remediation as its application for PFAS removal has been practiced over 15 years at 40 installations.^[9] GAC has been found to achieve effective removal of PFASs, especially long-chain (C>7) compounds.^{[9][10]} Both bituminous, or coal-based, and coconut-based carbon have been investigated for PFAS removal in the industry. CDM Smith recently performed a bench-scale Rapid Small-Scale Column Test (RSSCT) for another Massachusetts municipality to evaluate both coal-based and coconut-based carbon types in low-organic groundwater with elevated PFASs and found performance of the two carbons to be comparable, although no breakthrough of PFASs were observed during the study. With its

track record for PFOA and PFOS, GAC may be an effective solution for the Town, but the limiting factors for GAC's performance also need to be evaluated. Possible competitive adsorption with other compounds present in the water could hinder the PFAS removal by GAC, and removal effectiveness for shorter-chained compounds may be limited.

Testing of various GAC products has observed that GAC selection is of critical importance as certain products exhibited much earlier PFOS and PFOA breakthrough than other products, which makes testing with the Town's specific water matrix critical. Currently, there is minimal guidance on GAC selection for PFAS removal and little data on the GAC treatment and life cycle costs compared with competing technologies.

Sufficient GAC capacity and adsorption rates are desired for acceptable operating time between carbon changeouts. As presented in **Table 4**, low levels of dissolved and total organic carbon were observed in the Town's filtered effluent, suggesting very little organic interferences with PFAS adsorption on GAC. One of the major advantages of GAC is the lack of a waste stream and a related disposal concern, as spent activated carbon is either thermally destroyed or reactivated. However, infrequent GAC backwashing is expected, as backwashing is limited to washing the fines off the GAC during the first GAC fill and at every GAC changeout.

CDM Smith emphasizes that testing is critical for system design and cost performance to confirm that GAC is a viable solution for the specific water matrix of the Town's groundwater. If the PFAS treatment is to be placed downstream of greensand filters, the impact of the chlorine and permanganate residuals on GAC is another unknown for estimating GAC longevity with respect to PFASs. In addition, it should be noted that GAC's effectiveness for PFAS adsorption is known to decrease with shorter carbon chain compounds. The fate of federal or state regulations for short-chain compounds is more unclear than long-chain PFAS. Therefore, testing of GAC's performance with both long-chain and short-chain PFAS would result in valuable data to support long-term reliability of a GAC-based PFAS treatment process.

5.2 Anion Exchange

Ion exchange involves the use of synthetic resins with a fixed charge, which are used to remove charged contaminant ion through the exchange sites of the resin beads. PFASs are generally present in the environment in their anionic form with a negative charge, and therefore, anion exchange is capable of removing PFASs from water. Factors that influence anion exchange performance include influent contaminant concentration, treatment design (e.g., flow rate, resin bead size and material), and competing ion concentrations, such as sulfate, nitrate, bicarbonate, etc.

Although used less extensively than GAC, anion exchange has shown effectiveness at removing long-chain PFASs, especially for PFOS as it has shown more effective PFOS removal than GAC.

^{[9][10][11]} Similar with GAC, low effectiveness of short-chain PFAS removal has been reported with anion exchange by researchers, but contradictory study results exist, which indicate faster kinetics and higher capacity with removing the short-chain PFBS than PFOS. ^[10] Recent piloting

examinations by others demonstrate that anion exchange as either a standalone treatment system or a polishing step following GAC can be very effective at short-chain PFAS removal. Anion exchange achieved removal of both long-chain and short-chain PFASs to a non-detect level for a high number of bed volumes treated from waters with both high (~20,000 ppt for six UCMR 3 compounds) and low (~100 ppt) influent PFAS concentrations and presence of competing anions.

Importantly, the anion exchange systems have higher capacities, which may lead to less frequent changeouts than GAC and lower operating costs, and have been tested to perform at much shorter empty bed contact times (EBCT) than GAC, resulting in smaller equipment footprint and capital cost. Ion exchange treatment typically accompanies a resin regeneration step and corresponding management of brine waste. However, the anion exchange systems that have been tested in recent years comprised single-use selective resins in a set-up similar to single-use GAC systems, and thus, no additional space needs are necessary for the resin regeneration equipment (e.g., salt), and no brine disposal provisions are required with such systems.

With potential cost savings, reduced space needs, and insignificant presence of competing anions in the water, anion exchange may be a viable PFAS treatment alternative to GAC for the Town, particularly if treatment of PFASs with chain lengths shorter than PFOA/PFOS is desired. Also, a possible alternative to consider is a combination of GAC and anion exchange to incorporate both adsorption and ion exchange mechanisms. In this treatment train, more strongly adsorbing PFASs are initially removed by GAC and the more weakly adsorbing PFASs are removed by subsequent anion exchange. ^{[9][12]} This approach would enable the possibility of resin regeneration as more weakly adsorbed PFASs are easier to desorb. Depending on space availability to accommodate regeneration equipment, the ability to restore the resin capacity and avoid purchase of new resin may be favorable for long-term operating costs of anion exchange treatment.

5.3 Membranes

The applications of pressure-driven membrane technologies are widely applied in water treatment, but their applications in PFAS removal still require more thorough investigation. Microfiltration and ultrafiltration are unsuitable for PFAS removal, due to their molecular weight cut-off (MWCO) values being too high. Therefore, reverse osmosis (RO) and nanofiltration (NF) with lower MWCO properties have been studied for PFAS removal application, with RO having demonstrated significant removal of all the PFAS, including the short-chain compounds. Data on NF performance are more limited, but positive bench-scale test results have been reported for removal of PFAS with a range of molecular weights. ^{[9][10]} However, the MWCO properties may vary from different NF membrane materials, so NF's applicability needs to be confirmed through testing.

RO membranes have the same MWCO properties across manufacturers and thus should offer very high removal efficiency compared to other treatment alternatives. However, despite RO's effectiveness, it would be the most costly method for removal, due to high capital cost and energy demand. Importantly, both RO and NF generate a waste stream containing high concentrations of reject contaminants, and the management and treatment of the waste stream must be addressed in

design. Also, RO and NF are susceptible for fouling, and thus a pre-treatment step may be required to address the high fouling tendencies. Overall, like GAC and anion exchange, treatment with membranes would need to be investigated further and validated at bench- or pilot-scale.

Although membrane technologies may offer high PFAS reduction as well as multi-contaminant removal beyond PFASs, high capital and operating costs and fouling potential are major disadvantages. In addition, the potential PFAS regulations in Massachusetts will likely focus on addressing long-chain PFASs, which reduces the need for the treatment intensity that membranes offer. Finally, the existing finished water quality produced by the Grove Pond WTP is excellent in all criteria other than PFAS, further reducing the need for multi-contaminant removal.

5.4 Oxidation

PFASs are generally resistant to advanced oxidation processes (AOP) that use generated hydroxyl radicals to transform contaminants. AOPs with hydrogen peroxide or peroxydisulfate have been demonstrated to be ineffective at breaking down organic compounds, generally showing less than 10% removal of PFASs at the expense of significant energy input. ^{[9][10][11]} However, other emerging oxidation and reduction technologies (e.g., photocatalytic oxidation, photochemical oxidation and reduction, persulfate radical treatment, thermally induced reduction) have the potential to degrade PFASs, but they are presently not practiced in water treatment applications and are still in early stages of development. Therefore, oxidation technologies are not recommended for further consideration or testing in Ayer.

6.0 Bench-Scale Testing Recommendations

For the reasons discussed in Section 5, CDM Smith recommends bench-scale testing to evaluate the effectiveness of PFAS removal by GAC and anion exchange. The groundwater quality characteristics including low levels of organics and competing anions, existing iron and manganese reduction achieved by greensand filtration, the rapidly evolving regulatory atmosphere regarding long-chain PFASs, and lower capital and operating costs compared to membranes make both technologies viable treatment alternatives for further investigation. While GAC is, at present, the most prevalent PFAS technology, anion exchange offers appreciable potential cost savings and removal effectiveness of both long- and short-chain PFAS.

While GAC has been used to remove PFASs in many drinking water applications, the effectiveness of GAC for the specific water impacting the Town's groundwater needs to be demonstrated and verified to facilitate design. Specific concerns include the number of bed volumes treated until breakthrough and carbon changeout rates that will be required to maintain PFASs below the treatment goal, as it is possible that relatively rapid breakthrough could occur, which has been observed at other sites with PFAS contamination.

The importance of addressing these concerns during testing cannot be overstated as the design decisions made off the data and information gained can be directly related to long-term operating cost savings. For example, the cost difference associated with GAC changeout is significant

depending on the time to breakthrough. The estimated operating cost for the changeout frequency of every six months is \$230,000 while for every year it is \$120,000, assuming \$1.40 per one pound of GAC and changeouts from two 40,000-lb vessels at a time. This difference would add up to a significant expenditure over the life-time of the GAC system.

The ability to treat the broader suite of PFASs are also of interest to the Town for long-term treatment performance and future regulatory updates on PFASs. This is also a particular concern because subsequent chlorination of the water may oxidize fluorine-containing compounds, known as precursors, that can form longer-chain PFASs like PFOA and PFOS, due to hypochlorite oxidation. Recent research has shown that anion exchange may be cost-competitive with GAC for PFAS removal, in particular for short-chain PFASs, and selection of proper resin may allow for longer operation.

The same questions in terms of the bed volumes until breakthrough, carbon changeout rates, removal of PFASs of various carbon-chain lengths, and impacts of chemical addition also apply for evaluating treatment with anion exchange. CDM Smith recommends that testing to assess these critical questions should be performed prior to implementing any full-scale PFAS treatment systems that require significant capital expenditures by the Town. Therefore, CDM Smith recommends the following bench-scale testing objectives for evaluating the Town's PFAS treatment alternatives.

1. Assess the extent to which oxidation of the raw water results in formation of perfluoroalkyl acids.
2. Determine the time for breakthrough of each target PFAS for treatment via 1) GAC, 2) anion exchange, and 3) GAC followed by anion exchange.
3. Determine the nature of PFASs (e.g., PFOA, PFOS, and shorter-chain PFASs) that break through.
4. To mitigate potential rapid exhaustion of resin by quickly eluting short-chain compounds, determine the technical and economic efficacy of performing brine regeneration on the anion exchange resin to prolong resin life.

This information will be used to confirm the efficacy of using GAC and/or anion exchange to remove PFASs from the groundwater, identify the most appropriate product, and provide a well-founded basis for the sizing of the vessels needed for treatment. The various PFAS treatment technology configurations considered for GAC and anion exchange are summarized in **Figure 4**.

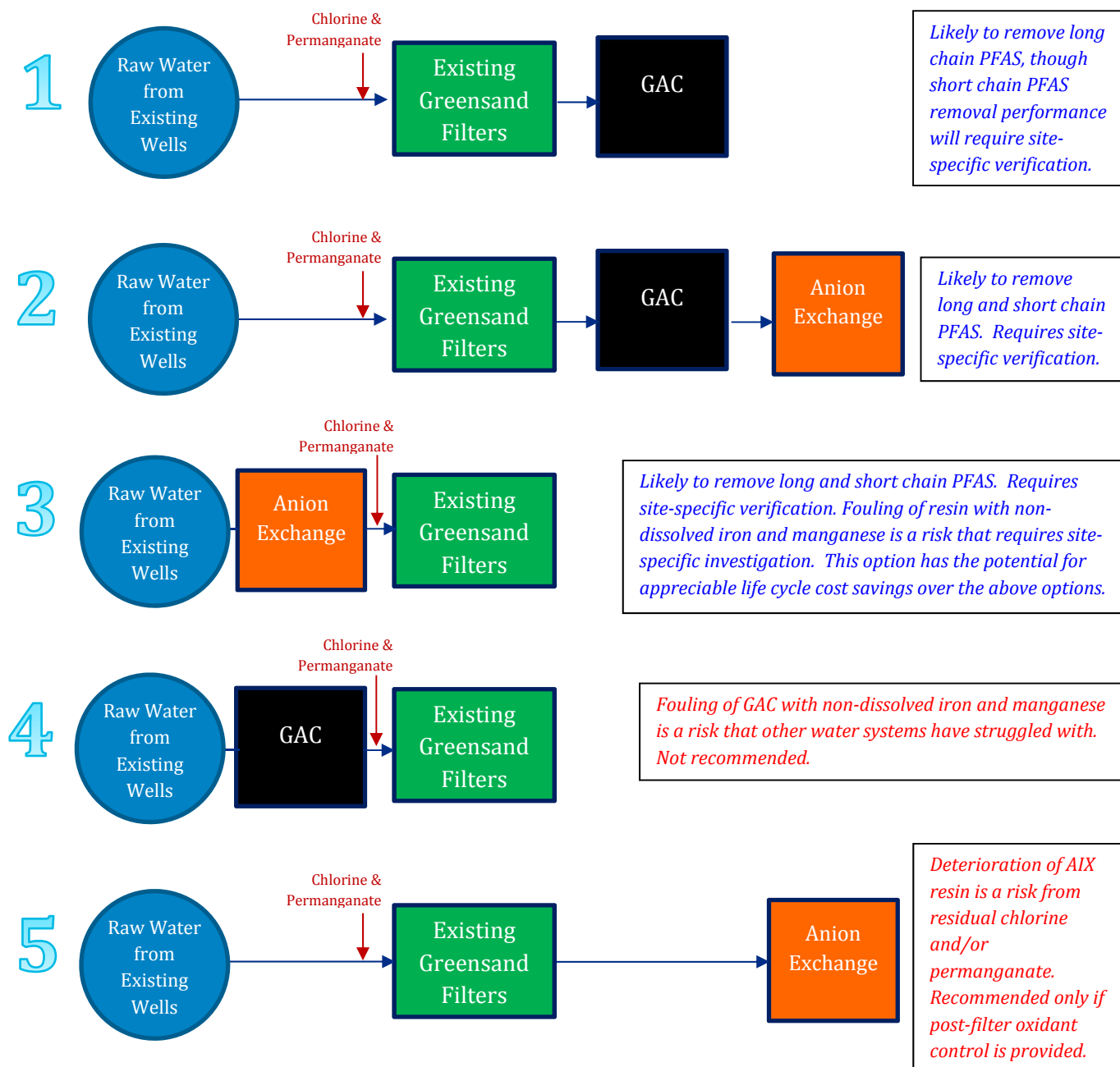


Figure 4. Schematic of PFAS treatment technology configurations considered for GAC and AIX at Ayer's Grove Pond WTP.

The proposed treatment trains for column testing are illustrated in **Figure 5**. The schematic includes testing of two (2) GAC products, possibly coal-based and coconut-based, and one (1) anion exchange resin product used for active bench- and pilot-scale investigations on long- and short-chain PFAS removal. A third alternative includes one of the two GAC products to remove longer-chain PFASs followed by one of the two anion exchange resin products as a polishing step to remove remaining PFASs. For anion exchange, if the smaller chain PFASs start to break through, a brine regeneration will be conducted to evaluate the regenerability of the resin. Also, not shown in the schematic are a control column and the duplicate test conditions for quality control. This set-up will evaluate the overall PFAS removal performance of GAC and anion exchange individually and the combination of the two technologies.

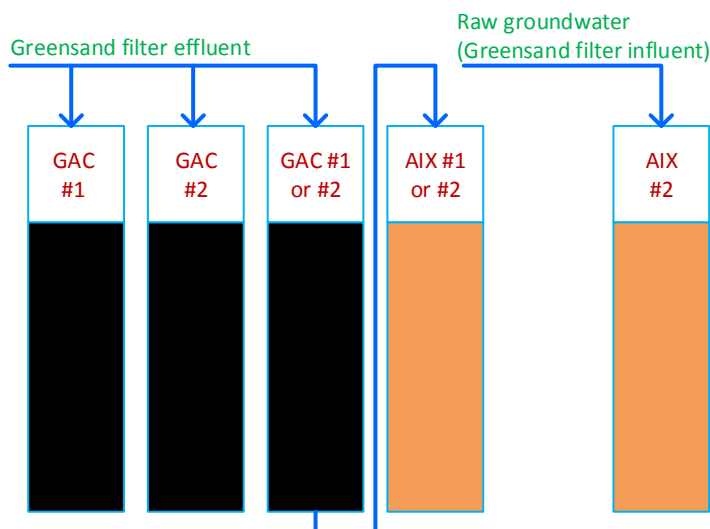


Figure 5. Schematic of proposed PFAS treatment technologies using 1) two GAC products; 2) one anion exchange (AIX) resin product; and 3) one GAC column followed by one AIX resin column.

CDM Smith notes that this testing approach aims to investigate two different water matrices and thus requires water sampling at two different locations in the Grove Pond WTP:

1. GAC will treat the effluent water from the existing greensand filters because iron and manganese are already removed from this water, and thus inorganic fouling potential is low, which has been a reported issue in GAC treatment of groundwater with high levels of iron. The greensand filter effluent typically carries chlorine and permanganate residuals. Limited levels of free chlorine residuals are not expected to affect GAC's adsorption capacity. Regarding permanganate, high levels can result in manganese loading on the GAC over time, which can adversely affect long-term use of GAC. Presently, the permanganate residual levels are not known. The effects of the oxidant residuals will be evaluated during bench-scale testing.

2. Anion exchange will treat the plant's raw water collected prior to entering the greensand filters. This is because any presence of oxidants, such as chlorine and permanganate used at the Grove Pond WTP, are detrimental to the physical integrity of the resin beads. Iron and manganese are unlikely to interfere with the PFAS removal, especially the single-use anion exchange system is designed for short-term use, compared to regenerable resin with longer expected life, but this, along with a potential for fouling, needs to be investigated through testing.
3. Treating greensand-filtered water with anion exchange is a viable option as long as oxidant residuals are minimized with a dechlorination step that will protect the integrity of the downstream anion exchange resin.

The proposed bench-scale tests can take place at CDM Smith's Research & Testing Laboratory in Bellevue, WA where similar column tests are regularly performed for removal of various contaminants, including PFASs. The column testing will also involve monitoring of flow rates, dosing of chlorine and permanganate into the column influent water to simulate the residuals exiting the greensand filters, regenerability of the anion exchange resin, and sampling of the raw and treated water for analyzing PFASs and other anions of concern. Final sampling events will be amended with chlorine and potassium hydroxide at the typical doses applied at the Grove Pond WTP for their impacts on PFAS concentrations. The estimated cost for the proposed bench-scale testing is on the order of \$150,000, with the majority of the pricing dedicated for PFAS analyses by an outside laboratory.

7.0 Preliminary Design Criteria

The design criteria for the three source water wells and the Grove Pond WTP, as indicated in the MassDEP permit and the Town's Operation and Maintenance manual, are presented below.

Table 5. Wells No. 6, 7 and 8 and Grove Pond WTP Design Criteria

Design Criteria	Well 6	Well 7	Well 8	Treatment Design Capacity [1]
Nominal Capacity, gal/min	694	617	600	1,389
Nominal Capacity, mgd	1.00	0.89	0.86	2.0
Nominal Capacity, ft ³ /sec	1.5	1.4	1.3	3.1
Existing Raw Water Well Pumps	785 gpm, 100 hp	710 gpm, 100 hp	600 gpm, 100 hp	N/A

Note: [1] The treatment design capacity is 2 mgd per BRP WS 20 permit by Mass DEP and is not equal to the sum of the three wells' individual reported nominal capacities

7.1 GAC

CDM Smith reviewed GAC literature and proposals provided by Calgon and Evoqua regarding equipment sizing and features. A summary of basic GAC contactor design criteria appears in the following table.

Table 6. GAC Contact Vessels Design Criteria

Granular Activated Carbon (GAC) Vessels	Minimum	Average	Maximum
Process Design Capacity, gal/min	417	694	1,389
Process Design Capacity, mgd	0.6	1.0	2.0
Process Design Capacity, ft ³ /sec	0.9	1.5	3.1
Parallel Operation Empty Bed Contact Time, minutes	95.8	57.5	28.7
Parallel Operation Surface Loading Rate During Filtration, gpm/sf	0.9	1.5	3.1
Lead-Lag Operation Empty Bed Contact Time, minutes	47.9	28.7	14.4
Lead-Lag Operation Surface Loading Rate During Filtration, gpm/sf	1.8	3.1	6.1
Target Backwash Rate, gpm/sf	9.0		
Target Backwash Rate, gpm	1,018		
Design Duration for Backwash, minutes	30		
Spent Filter Backwash Volume, gallons	30,536		
Number of Vessels Installed	4		
Vessel Diameter, ft	12		
Cross-Sectional Area per vessel, square feet	113.1		
Carbon Weight per vessel, lb	40,000		
Assumed carbon density, pounds per cubic foot	30		
Carbon Bed Depth, ft	11.8		
Estimated Vessel Height, ft	26.8		
Carbon Bed Volume per vessel, cubic feet	1,333		

Per discussion with the Town, the area on the east of the Grove Pond WTP building has been identified as the available space for the addition of the PFAS treatment facility. **Figure 6** shows a preliminary site plan of the new building to house the GAC vessels. The site plan was created with the GAC systems to estimate a conservative space requirement, given that the area to accommodate anion exchange vessels is less. Infrequent GAC backwashing is expected, as backwashing is limited to washing the fines off the GAC during the first GAC fill and at every GAC changeout.

7.2 Anion Exchange

A summary of anion exchange contactor design criteria is presented in the following table. This design assumes a single-use resin system with no regeneration or backwash required.

Table 7. Anion Exchange Vessels Design Criteria

Anion Exchange Resin Vessels	Minimum	Average	Maximum
Process Design Capacity, gal/min	417	694	1,389
Process Design Capacity, mgd	0.6	1.0	2.0
Process Design Capacity, ft ³ /sec	0.9	1.5	3.1
Number of Vessels Installed	2		
Vessel Diameter, ft	12		
Cross-Sectional Area per vessel, square feet	113.1		
Bed Depth, ft	6.0		
Bed Volume per vessel, cubic feet	570		
Parallel Operation Empty Bed Contact Time, minutes	20.5	12.3	6.1
Parallel Operation Surface Loading Rate During Filtration, gpm/sf	1.8	3.1	6.1
Lead-Lag Operation Empty Bed Contact Time, minutes	10.2	6.1	3.1
Lead-Lag Operation Surface Loading Rate During Filtration, gpm/sf	3.7	6.1	12.3

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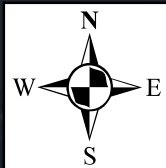


Figure 6. Preliminary Site Plan of PFAS Treatment Facility at Grove Pond WTP
Ayer, Massachusetts
March 2018

8.0 Opinion of Probable Project Cost

8.1 PFAS Treatment

CDM Smith collected budget proposals from Calgon, Purolite, and Evoqua on the GAC and anion exchange equipment. The following table summarizes the equipment offerings by each vendor, including the capital costs. Overall, the equipment cost for GAC systems from Calgon and Evoqua and anion exchange system from Purolite were comparable to each other, with the anion exchange system from Evoqua having the lowest cost by a significant margin.

Table 8. GAC and Anion Exchange Equipment Offerings and Costs

Vendor	System	Product	# of Vessels	Vessel Diameter	Capital Cost	Comment
Calgon	GAC	12-40 Systems & F400 GAC	4	12 ft	\$ 900,000	Initial fill of 40,000 lb of <u>coal-based</u> GAC.
Purolite*	AIX	PFA694E Resin	2	12 ft	\$ 880,000	Initial fill of 570 cubic feet of resin per vessel
Evoqua	GAC	HP1020SYS System & AC1230CX GAC	4	10 ft	\$ 830,000	Initial fill of 18,000 lb of <u>coconut-based</u> GAC
Evoqua	AIX	HP1120HF System & PSR2-PLUS Resin	2	12 ft	\$ 520,000	Initial fill of 424 cubic feet of resin per vessel

*Purolite is a resin manufacturer and does not manufacture their own vessels.

In order to develop the opinion of probable construction cost (OPCC), the GAC price from Calgon was used for the most conservative estimate. In addition, the following assumptions were used in developing the OPCC, summarized in **Table 9**.

- Two (2) GAC systems with total four (4) vessels are housed in a connected building. This building is 8 feet away from the eastern side of the existing plant and is connected to the existing building through a breezeway.
- Preliminary dimensions for the new building are 43'-4" by 41'-8" with the total area of approximately 1,800 ft². The dimensions assume a 6-foot-wide space around the GAC vessels and 3-foot-wide space between the two GAC vessel systems, and the building accommodates the tall GAC equipment of 21'-9" height.
- The new building consists of concrete masonry units (CMU) and the same structural details as the existing plant building.
- Civil yard piping assumes cutting into the filtered water line, rerouting it to feed the GAC system, and the GAC effluent returning to the existing plant in the same pathway to tie into the existing filtered water DI pipe prior to chemical injection. The backwash piping needs to be modified for extending supply to GAC and retrieving spent filter backwash.

- No backwash supply pumps or spent filter backwash handling systems are included. The existing backwash facility was assumed to have an adequate capacity to accommodate the infrequent backwashing events of the GAC vessels.
- Allowances are included for plumbing, HVAC, I&C, and electrical work. No dehumidification is assumed in the HVAC allowance.
- A \$30,000 allowance is assumed for a manlift for access to the top of the GAC vessels.
- No rock excavation is required, and only nominal dewatering is needed.
- No allowance for contaminated soils or hazardous materials is included (i.e., asbestos, lead, etc.).

Table 9 also presents the breakdown summary of the total project cost. The total cost estimate for bench-scale testing, OPCC, and engineering services is \$5.7 million.

Table 9. Opinion of Probable Project Cost

Sitework, Yard Piping, Earthwork, Concrete, Precast Concrete, CMU Building, Structural Steel, Membrane Roofing	\$ 630,000
4 GAC Contactors with Piping and Valving for Lead/Lag or Parallel Operations	\$ 930,000
HVAC Allowance	\$ 90,000
I&C Allowance	\$ 150,000
Plumbing Allowance	\$ 30,000
Electrical Allowance	\$ 300,000
Manlift Allowance	\$ 30,000
Subtotal	\$ 2,200,000
General Contractor General Conditions, Overhead & Profit, Taxes, Insurance, Permits	\$ 610,000
Subtotal for Prime Contractor (January 2018 Dollars, ENR 20-City Index 10,878)	\$ 2,800,000
Construction Contingency (25%)	\$ 700,000
Subtotal	\$ 3,500,000
Opinion of Probable Construction Cost, Escalated to Midpoint of Construction (2 years)	\$ 3,800,000
Bench-Scale Testing	\$ 150,000
Engineering Services during Design and Bidding	\$ 400,000
Engineering Services during Construction (15%)	\$ 500,000
Implementation Subtotal	\$ 4,850,000
Project Contingency (15%)	\$ 800,000
Total Project Cost	\$5.7 Million

8.2 Water Purchase from Devens

The Town has been continuing a dialogue with personnel from neighboring Devens regarding the availability and cost of purchasing water from Devens. According to the water rates issued by Devens Utilities Department on July 1, 2017, the water rate for the >30,000 gallons/quarter tier is \$4.45/1000 gallons. If the Town is to purchase from Devens for the average flow rate of 1 mgd through the Grove Pond WTP assumed as the demand, the purchase costs are \$4,450 per day and \$1.6 million per year.

Comparing this number to the project cost estimate of \$5.7 million, the new PFAS treatment addition would be paid off before the end of the 3rd year of purchasing water from Devens. It should be highlighted that this cost assumes no annual flat fee, which is typically charged to larger users by Devens, no increase in water rates, and no provisions for evaluating and establishing the interconnection with Devens, so the actual cost will be higher than the cost of the water usage. Therefore, purchasing water from Devens is not considered as a sustainable solution for addressing the Town's elevated PFAS levels in the source water.

9.0 MassDEP Permitting

For the new treatment addition, Form BRP WS 25 Approval of Treatment Facility Modification will need to be submitted, along with an Engineer's Report describing the facility and design criteria. Since this project will include no expansion or new withdrawals involved with this treatment addition, it will not exceed the Massachusetts Environmental Policy Act (MEPA) thresholds and thus will not require a review by the MEPA Office. CDM Smith assumed that the new treatment addition is not considered a new water treatment plant, and this will be verified with the MEPA office during the design phase. In addition, the project site is not located in any wetland zone or protected area for endangered species.

During the design phase of the project, the requirements for potential local permits with town officials should be verified (e.g., the Conservation Commission and the Planning Board). It is also advisable to begin coordinating with the officials from the Building Department and Fire Department regarding the requirements for the new building addition.

10.0 Project Schedule

The following table summarizes a preliminary timeline for proposed sequence of bench-scale testing, project permitting, design, bidding, and construction.

Table 10. Proposed Project Implementation Schedule

		2018										2019												2020		
		Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Project Development Activity																										
1	PFAS Summary Report																									
2	Bench Scale Testing Work																									
3	Land Survey																									
4	Geotechnical Investigation																									
5	Permitting																									
6	Preliminary Design of Site Work, Yard Piping, and Process Mechanical Layout ⁽¹⁾																									
	90 Percent Design																									
	MassDEP's BRP WS 25 Review and Approval																									
	100 Percent Design																									
7	Bidding and Award																									
8	Construction																									
9	Startup																									
Other																										
	Workshops with Town of Ayer																									
	Opinions of Probable Construction Cost																									
	General Project Management																									

Notes: ⁽¹⁾ While bench scale testing work proceeds, preliminary design of a generic (GAC or IX) pressure vessel system will be developed in the arrangement depicted in Figure 6.

11.0 Additional Topics for Design

- A professional land survey is required prior to the final design to determine the boundaries of the project site to depict compliance with setback requirements, any easements for utilities, to ensure detailed grading design around the new building, etc.
- A geotechnical investigation will be conducted during final design, and include borings to identify depth of groundwater table and soil bearing capacity for use in designing the building foundations.
- The existing electrical system will be verified by an electrical engineer to ensure it can support the additional load from the PFAS treatment process.
- The sequencing of GAC installation relative to startup should be planned carefully. The Town will benefit if the GAC does not reach exhaustion simultaneously in each of the contactors.
- Life cycle costs for removal and replacement of exhausted GAC or AIX resin or reactivation of exhausted GAC can be estimated at the conclusion of bench-scale testing and should be included in the Town's annual operating budget.

12.0 Recommendations

From the information gathered as a result of the research and analysis for this memorandum, the following summary of recommendations is presented.

- CDM Smith recommends that the Town conduct the bench-scale test to determine which PFAS treatment alternative will meet the Town's needs for PFAS removal. Bench-scale testing will provide valuable data for selecting the effective treatment that will meet the treatment goals, provide information on design parameters, and be favorable in capital and operating costs. The scope for the testing can be discussed and adjusted as necessary.
- The Town should continue communicating with MassDEP on the upcoming PFAS regulations and their effects on the Town's water supply.
- The Town is advised to use the presented cost estimates for the project as a guideline and direct its financial resources as necessary.
- Since many aspects of the design phase for the PFAS treatment addition do not rely on the results of the bench-scale testing (e.g., surveying, geotechnical investigation, electrical system verification), these tasks are recommended to be performed alongside the bench-scale testing work, as shown in the proposed schedule.
- Since any presence of oxidant levels is not desirable for downstream PFAS treatment, the Town should keep in mind that a plan may need to be developed in the near future to

optimize the existing treatment processes to reduce the oxidant residual leaving the filters as much as possible, without hindering the existing iron and manganese removal performance.

References

- [1] USEPA (2016). Fact Sheet PFOA & PFOS Drinking Water Health Advisories. EPA 800-F-16-003.
- [2] NHDES. (2016). NHDES Establishes Ambient Groundwater Quality Standard for Perfluorooctanoic Acid (PFOA) and Perfluorooctane Sulfonate (PFOS).
<https://www.des.nh.gov/media/pr/2016/20160531-pfoa-standard.htm>.
- [3] Maine CDC (2017). Summary of the 2016 Updates to the Maximum Exposure Guidelines.
<http://www.maine.gov/dhhs/mecdc/environmental-health/eohp/wells/documents/megchanges2016.pdf>.
- [4] DWQI (2015). New Jersey Drinking Water Quality Institute. Health-Based Maximum Contaminant Level Support Document: Perfluorononanoic Acid (PFNA).
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- [9] National Ground Water Association (2017). Groundwater and PFAS: State of Knowledge and Practice. Westerville, Ohio.
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Mr. Mark Wetzel – Town of Ayer
March 21, 2018
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[12] Dudley, L.A., E.C. Arevalo, and D.R. Knappe (2015). Removal of Perfluoroalkyl Substances by PAC Adsorption and Anion Exchange - 4344 report. Denver, Colorado: Water Research Foundation.

cc: Lisa Gove, CDM Smith
CDM Smith Project File 224946

Appendix A

MassDEP Permit for BRP WS 20 and WS 25



Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

Central Regional Office • 627 Main Street, Worcester MA 01608 • 508-792-7650

DEVAL L. PATRICK
Governor

TIMOTHY P. MURRAY
Lieutenant Governor

RICHARD K. SULLIVAN JR.
Secretary

KENNETH L. KIMMELL
Commissioner

April 03, 2012

Ayer Public Works Department
Attn: Richard Linde
25 Brook Street
Ayer, MA 01432

Re: Ayer
PWS Name: Ayer Water Department
PWS ID #: 2019000
Program: System Modification BRP WS 20 & 25
Action: Approved
Activity: MassDEP Trans.# X250327 & X250328

Dear Mr. Linde:

Please find attached the following information:

- An approval for BRP WS 20 Construct new Source and BRP WS 25 Treatment Facility Modifications for Grove Pond Water Treatment Facility, Ayer, Massachusetts.

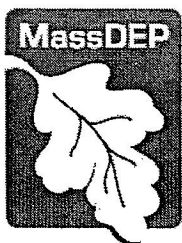
Please note that the signature on this cover letter indicates formal issuance of the attached document. Thank you, and if you have any questions regarding this matter, please feel free to contact Barbara Kickham or Margo Webber of the Drinking Water Program at 508-767-2724 or 508-767-2738 respectively. Feel free to contact me as well at 508-767-2827

Sincerely,

Marielle Stone *for*
Section Chief
Drinking Water Program

Cc: Ayer Board of Health, Town Hall, Ayer MA 01432
Susan Hunnewell, On-Site Engineering, 279 East Central Street, PMB 210, Franklin, MA 02038

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Department of Environmental Protection

Central Regional Office • 627 Main Street, Worcester MA 01608 • 508-792-7650

DEVAL L. PATRICK
Governor

TIMOTHY P. MURRAY
Lieutenant Governor

RICHARD K. SULLIVAN JR.
Secretary

KENNETH L. KIMMELL
Commissioner

Ayer Water Department, PWS ID # 2019000
BRP WS 20 – Construction of a Source >70 gpm
BRP WS 25 – Treatment Facility Modification
Grove Pond Water Treatment Facility Expansion

Date: April 03, 2012

1. Applicant and Permit Information

Name of Permittee: Ayer Water Department ("Applicant")
Mailing Address: 25 Brook Street, Ayer, MA 01432
Permit Name: Construct Source and Treatment Facility Modification
Permit Code: BRP WS 20 and BRP WS 25
Transmittal Numbers: X250328 and X250327

2. Facility Information

Name of Facility: Grove Pond Treatment Facility
Facility Address: off Barnum Road, Ayer, MA 01432
Facility Owner: Ayer Water Department
Owner's Address: 25 Brook Street, Ayer, MA 01432
PWS Name: Ayer Water Department
PWS Type: Community (COM)
PWS ID Number: 2019000

3. Facility Description

Ayer Water Department (AWD) is a community public water system located in the Town of Ayer, Massachusetts and serves a drinking water population of approximately 6,800 persons per day. The service area has 2,452 service connections consisting of 2,315 residential connections and approximately 118 commercial, and 19 municipal connections. The public water system currently obtains its water from five wells, two wells near Grove Pond that are treated at the Grove Pond Water Treatment Facility, and three wells near Spectacle Pond that are treated at the Spectacle Pond Water Treatment Facility.

Three additional wells will be constructed to expand the existing Grove Pond well site. Existing gravel packed Wells #1 and #2 are located adjacent to Grove Pond off of Barnum Road. Well #1 (PWS ID #2019000-01G), constructed in 1943, is a 24 by 20-inch diameter gravel packed well, drilled to a depth of 62-feet with 40-feet of casing and an 18-foot long screen. The well has an approved pumping rate of 694 GPM, and an approved pumping volume of 1.0 MGD. The approved pumping volume was determined as part of the conceptual Zone II delineation for this well. The Zone II for this source was approved in 1993.

Water is withdrawn from the well by a 60 HP submersible pump and delivered to Grove Pond Water Treatment Facility. The Zone I protective radius for the well is 400-feet.

Grove Pond Gravel Packed Well #2 (PWS ID # 2019000-02G), constructed in 1952, is a twenty-four-inch diameter gravel packed well that was drilled to a depth of 61-feet with 40-feet of casing and a 20-foot long 24-inch diameter screen. The well has an approved pumping rate of 780 GPM, and an approved pumping volume combined of 1.2 MGD. The approved pumping volume was determined as part of the conceptual Zone II delineation for this well, approved in 1993. Water is withdrawn from the well by a 75 HP submersible pump and delivered to Grove Pond Treatment Facility where the water is treated. The Zone I protective radius for the well is 400-feet.

4. Reviews and Approvals Affecting Current or Planned Operation

- 4.1 MEPA – The applicant is required to comply with all applicable filings and requirements of the Massachusetts Environmental Policy Act (MEPA) and approved ENF #14558.

4.2 Site Exam and Pumping Test Proposal BRP WS 17:

Application: “Town of Ayer – Replacement of Wells at Grove Pond”

Dated: October 27, 2006

Date of Application Receipt: October 30, 2006

Start Date of Application: October 31, 2006

Prepared by: Tata & Howard, Inc.

Contact: Susan Hunnewell

Zone I - Memorandum of Understanding with US Army National Guard on
Groundwater Supply Protection

Dated: February 23, 2007

Supplemental Information, re Grove Pond Replacement Wells

Dated: April 11, 2007

Prepared by: Tata & Howard, Inc.

4.3 Pumping Test Approval Application BRP WS19

Report: “Grove Pond Replacement Wells No. 1 and 2”

Dated: June 30, 2008

Prepared by: Tata & Howard, Inc.

Contact: Susan Hunnewell

Telephone: (508) 303-9400

Received by MassDEP-CERO: July 2, 2008

4.4 Site Exam and Pumping Test Proposal BRP WS 17:

Report: “Request for Site Exam and Pumping Test Proposal Grove Pond Well No. 3”

Dated: September 2007

Prepared by: Tata & Howard, Inc.

Received by MassDEP-CERO: October 1, 2007

Start Date of Application: October 1, 2007

Approved: January 16, 2008

- 4.5 Pumping Test Approval Application BRP WS 19
Report: "Source Final Report, Grove Pond Well 3"
Dated: March 2010
Prepared by: Tata & Howard, Inc.
Contact: Jenna Rzasas
Telephone Number: (508) 303-9400
Received by MassDEP-CERO: March 5, 2010
Addendum to Report Submitted: March 15, 2010
Zone II Map Received: August 26, 2010

5. Current Permit Application, Plans and Reports

- 5.1 Application Information
Applicant Name: Ayer Department of Public Works
Contact: DPW Director
Telephone: 978-772-8240
Permit Code: BRP WS 20 and BRP WS 25
Permit Name: Construct Source and Treatment Facility Modification
MassDEP Transmittal #: X250327 and X250328
Received by DEP-CERO: February 27, 2012 and February 23, 2012

- 5.2 Applications Prepared by
Susan Hunnewell, P.E.
On-Site Engineering
279 East Central Street, PMB 241
Franklin, MA 02038
Tel: 508-553-0616

6. Current Project Description

Grove Pond Wells 1A and 2A were permitted as replacement wells for existing Wells 1 and 2. Grove Pond Well 3 was permitted through the new source approval process. The Zone II for the three new sources was re-delineated. The top of the well casing for each well must be a minimum of 1.5 feet above the 100 year flood elevation. The low water shut-off must be 5 feet above the top of the screen. The new wells will be constructed as 18" by 12" gravel packed wells and will be completed with a pitless adaptor.

Additionally, the wells must be constructed in accordance with the following:

- The seal must be composed of a concrete grout mixture of equal parts cement and sand (See Guidelines, Chapter 4, Section 4.20.3 (2))
- The gravel pack must extend a minimum of 10 feet above the top of the well screen and one foot of transitional sand must be placed above the gravel pack, prior to the addition of the cement grout.
- The low water shut-off must be set 5 feet above the top of the screen; not 1 to 4 feet as indicated on Figure 2 of the Report.

- The wells casings must be vented to the atmosphere. The vent shall terminate in a down-turned position, above the 100-year flood plain. In order to avoid the installation of a high vent pipe for a well located in a floodplain, a directional vent pipe that vents at the pump house may be installed.

Well construction details are as follows:

	Well 1A	Well 2A	Well 3
Approved Maximum Pumping Volume (MGD)	1.0	0.89	0.86
	Grove Pond Well site is approved to pump a total of 2.0 MGD from all sources		
Approx. Top of Casing Elev. (ft-MSL)	229	229	237
Screen Length (ft)	10	15	13
Total Depth (ft-bgs)	57	74	73

The Town of Ayer Grove Pond Water Treatment Facility began operation in 1988 as a 1.0 MGD greensand filtration facility to remove iron, manganese and arsenic. Replacement Wells 1A and 2A and new Well 3, have an approved capacity of 2.0 MGD. The existing treatment facility was sized for 1.5 MGD, but has only been operating at 1.0 MGD. To expand the existing facility to meet the new withdrawal rate, additional greensand filtration units will be installed.

The existing Grove Pond Water Treatment Facility (2019000-02T), located adjacent to the Grove Pond Wells off Barnum Road, receives water from the Grove Pond Gravel Packed Wells. The facility has a design capacity 1.0 million gallons per day and provides treatment for the removal of arsenic, iron and manganese by green sand filtration, and corrosion control by chemical injection for pH adjustment.

The proposed modifications include the addition of four more green sand filtration units, (increased from 6 to 10), the addition of more office space, additional chemical injection ports, a second 73,000 gallon backwash settling tank and the ability to recycle settled backwash water back through the treatment process. The two replacement wells 1A and 2A and the new well #3 will each be enclosed in a fence. Water from the wells will pass by a check valve, a hydrant, a second check valve and to a new well house building. This 20 ft by 26 ft building will have all three wells enter separately, pass by a butterfly valve, a sample tap, a flow meter, another butterfly valve and then connect with the other two well lines. The three lines will combine into one 12 inch raw water line and go into the ground to travel 750 feet to the treatment building.

In the expanded treatment building, the flow will enter the building as an 8 inch line, pass by a sample port, the recycle line from the backwash tank, chemical injection nozzles for potassium permanganate, potassium hydroxide, sodium hypochlorite and a spare nozzle before going by the flow meter and through ten greensand filtration units. The finished water will discharge through an 8 inch line, past a magnetic flow meter, have additional chemical

addition for sodium hypochlorite and potassium hydroxide (and a spare nozzle) before going outside, changing to a 12 inch line and entering the distribution system. A one hundred foot tap will come back to the treatment building and will run through a chlorine, pH and turbidity analyzer. Backwash water from each greensand filtration unit will discharge through an 8 inch line outside to one of two 70,000 gallon backwash tanks (an existing tank and a new tank). Each backwash tank will have three compartments. Water will flow through the three tanks in a serpentine pattern. In the third chamber, two submersible pumps will be located to pump residual solids to the treatment facility, and a decanter will be located to pump decanted water back through the recycle line to the head of the plant.

7. Permit Review and Approval

This permit application complies with the requirements at 310 CMR 22.00 Drinking Water Program Regulations and MassDEP's Guidelines and Policies for Public Water Systems. MassDEP reviewed the permit application and supporting documentation, and hereby issues the permit/approval. In the event this permit conflicts with all or parts of prior approvals or permits, the terms and conditions of this permit shall supersede the conflicting provisions of prior permits and/or approvals. This permit does not convey property rights of any sort or any exclusive privilege. Pursuant to the MassDEP's authority under 310 CMR 22.04(7) to require that each supplier of water operate and maintain its system in a manner that ensures the delivery of safe drinking water to consumers, this permit is made subject to the conditions set forth below.

8. General Permit Conditions


- 8.1 Compliance with Permit Approvals - The Applicant shall conduct activities in accordance with the approved plans, reports, and other submissions described in Section-5 (Current Permit Application, Plans and Reports), except as may be modified by the conditions set forth in Section 8 (General Permit Conditions) and Section 9 (Specific Permit Conditions). No material changes in the design or activities described in the approved documents shall be performed without prior written MassDEP approval.
- 8.2 Compliance with Other Approvals - The construction, operation and maintenance of this Public Water System shall be performed in compliance with all other applicable local, state and federal laws and regulations. This approval does not relieve the owner or operator of this Public Water System from complying with all other applicable local, state and federal requirements, licenses and permits.
- 8.3 Duty to Mitigate - The Applicant shall remedy and shall act to prevent all potential and actual adverse impacts to public health or the environment resulting from noncompliance with the terms or conditions of the permit or approval.
- 8.4 Duty to Provide Information - The Applicant shall furnish to MassDEP, within a reasonable time, any information MassDEP may request, and which is deemed by MassDEP to be relevant in determining compliance with permits, regulations, guidelines and policies.

9. Specific Permit Conditions

- 9.1 Construction Certification - The Applicant shall submit to MassDEP, prior to the final inspection of the project, a copy of the Engineer's certification letter/report on the construction of the project, and its compliance with MassDEP's regulations, guidance and policies. The Engineer's report shall also include a final set of as-built plans, and show any changes from the submitted and approved plans and reports.
- 9.2 Operation and Maintenance Manual – The Applicant shall submit to MassDEP for review and approval an Operation and Maintenance (O&M) Manual for the treatment facility modifications, at least 30 (thirty) days prior to the final inspection of the facility.
- 9.3 Low Water Shut-off – Water levels in the wells must be at least five feet above the top of the screen.
- 9.4 Sample Taps – There should be a raw water sample tap on the manifolded line in the new well pump building and on the raw water line as it enters the Water Treatment Building. There should also be a sample tap on the line leaving the water treatment building and on the backwash line that goes to the backwash tanks.
- 9.5 Chemical Injection Locations – The current configuration is to add potassium permanganate and chlorine prior to the greensand filtration units for oxidation of iron, manganese and arsenic. A third spare injection port should be added for a coagulant if needed in the future. On the distribution side, there are two chemical injection ports for chlorine and pH control. A third spare injection port should be added for future corrosion control if needed.
- 9.6 Chemical Interlocks – The critical chemical metering pumps are interlocked with the well pump, the flow meter and the pH and chlorine analyzers on the 100 ft tap. Both the chemical metering pumps and well pump shall be turned off if the pH and/or Chlorine chemical analyzer is outside the designated acceptable range. All chemical addition shall be in compliance with the requirements of Chapter 6 of MassDEP Guidelines.
- 9.7 Backwash Tanks – The two backwash tanks, one existing and one new, will be behind the treatment facility building. Each tank will have three compartments. In the third compartment a decanter and submersible pumps will be located. A high water float shall be installed in the tank that in the event of a high water condition will call the operator and automatically turn on the submersible pumps to pump to the sewer.
- 9.8 Future Treatment – Please be advised that MPA tests will be required on the new well #3 after a year of operation. If this testing indicates that the well is Ground Water under the Direct Influence (GWUDI) of surface water, coagulant addition before the filters or additional treatment may be required to meet MassDEP Drinking Water Regulatory requirements.

- 9.9 New Addition – The new office addition will be constructed directly above the raw water line and finished water line where the 8" X 12" reducers are located. Care shall be taken during construction when building over these lines.
- 9.10 Final Inspection – MassDEP must be notified upon completion of construction so that MassDEP personnel may conduct the final inspection of the facility modifications. Please allow at least ten (10) working days for MassDEP personnel to schedule and conduct the necessary inspections.
- 9.11 Approval to Activate – Facility modifications approved under this permit may not be placed in service without written approval to activate, following MassDEP final inspections for this project.
- 9.12 Abandonment Permits – Existing Grove Pond Wells 1 and 2 will be removed from service after activation of Wells 1A, 2A, and 3. Please submit BRP WS 36 permits for each abandoned well within 60 (sixty) days of the activation of the wells.

Thank you, and if you have any questions regarding this matter, please feel free to contact Margo Webber of this office at 508-767-2738, or Barbara Kickham at 508-767-2724. You may also contact me at 508-767-2827.



Marielle Stone *for*
Section Chief
Drinking Water Program

Appendix B

24-Compound PFAS Analysis Results



ANALYTICAL REPORT

Lab Number:	L1747009
Client:	Town of Ayer Town of Ayer - Public Works Department 25 Brook Street Ayer, MA 01432
ATTN:	Dan Van Schalkwyk
Phone:	(978) 772-8420
Project Name:	TOWN OF AYER
Project Number:	Not Specified
Report Date:	01/03/18

The original project report/data package is held by Alpha Analytical. This report/data package is paginated and should be reproduced only in its entirety. Alpha Analytical holds no responsibility for results and/or data that are not consistent with the original.

Certifications & Approvals: MA (M-MA086), NH NELAP (2064), NJ NELAP (MA935), CT (PH-0574), IL (200077), ME (MA00086), MD (348), NY (11148), NC (25700/666), PA (68-03671), RI (LAO00065), TX (T104704476), VT (VT-0935), VA (460195), USDA (Permit #P330-14-00197).

Eight Walkup Drive, Westborough, MA 01581-1019
508-898-9220 (Fax) 508-898-9193 800-624-9220 - www.alphalab.com



Project Name: TOWN OF AYER
Project Number: Not Specified

Lab Number: L1747009
Report Date: 01/03/18

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L1747009-01	MULT4-GROVE POND WTF	DW	GROVE POND	12/20/17 09:35	12/20/17
L1747009-02	RW-06G-GROVE WELL #6	DW	GROVE POND	12/20/17 09:55	12/20/17
L1747009-03	RW-07G-GROVE WELL #7	DW	GROVE POND	12/20/17 09:55	12/20/17
L1747009-04	RW08G-GROVE WELL #8	DW	GROVE POND	12/20/17 09:55	12/20/17
L1747009-05	FIELD BLANK	DW	GROVE POND	12/20/17 10:00	12/20/17

Project Name: TOWN OF AYER
Project Number: Not Specified

Lab Number: L1747009
Report Date: 01/03/18

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet NELAP requirements for all NELAP accredited parameters unless otherwise noted in the following narrative. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. Tentatively Identified Compounds (TICs), if requested, are reported for compounds identified to be present and are not part of the method/program Target Compound List, even if only a subset of the TCL are being reported. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively. When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. All specific QC information is also incorporated in the Data Usability format of our Data Merger tool where it can be reviewed along with any associated usability implications. Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances the specific failure is not narrated but noted in the associated QC table. The information is also incorporated in the Data Usability format of our Data Merger tool where it can be reviewed along with any associated usability implications.

Please see the associated ADEx data file for a comparison of laboratory reporting limits that were achieved with the regulatory Numerical Standards requested on the Chain of Custody.

HOLD POLICY

For samples submitted on hold, Alpha's policy is to hold samples (with the exception of Air canisters) free of charge for 21 calendar days from the date the project is completed. After 21 calendar days, we will dispose of all samples submitted including those put on hold unless you have contacted your Client Service Representative and made arrangements for Alpha to continue to hold the samples. Air canisters will be disposed after 3 business days from the date the project is completed.

Please contact Client Services at 800-624-9220 with any questions.

Project Name: TOWN OF AYER
Project Number: Not Specified

Lab Number: L1747009
Report Date: 01/03/18

Case Narrative (continued)

Sample Receipt

L1747009-02: The sample identified as "RW-06G-GROVE WELL #6" on the chain of custody was identified as "(B)RW-07G-GROVE WELL #7 and (C)RW08G-GROVE WELL #8" on the container label. At the client's request, the sample is reported as "RW-06G-GROVE WELL #6".

Perfluorinated Alkyl Acids by Isotope Dilution

L1747009-01: The Extracted Internal Standard recoveries were outside the acceptance criteria for perfluoro[13c4]butanoic acid (mpfba) (40%), 1h,1h,2h,2h-perfluoro[1,2-13c2]hexanesulfonic acid (m2-4:2fts) (167%), perfluoro[13c9]nonanoic acid (m9pfna) (152%), perfluoro[1,2,3,4,5,6-13c6]decanoic acid (m6pfda) (164%) and 1h,1h,2h,2h-perfluoro[1,2-13c2]decanesulfonic acid (m2-8:2fts) (309%).

L1747009-02: The Extracted Internal Standard recoveries were outside the acceptance criteria for perfluoro[13c8]octanesulfonamide (m8fosa) (25%), 1h,1h,2h,2h-perfluoro[1,2-13c2]hexanesulfonic acid (m2-4:2fts) (171%), perfluoro[1,2,3,4,5,6-13c6]decanoic acid (m6pfda) (153%) and 1h,1h,2h,2h-perfluoro[1,2-13c2]decanesulfonic acid (m2-8:2fts) (289%).

L1747009-03: The Extracted Internal Standard recoveries were outside the acceptance criteria for 1h,1h,2h,2h-perfluoro[1,2-13c2]hexanesulfonic acid (m2-4:2fts) (172%) and 1h,1h,2h,2h-perfluoro[1,2-13c2]decanesulfonic acid (m2-8:2fts) (259%).

L1747009-04: The Extracted Internal Standard recoveries were outside the acceptance criteria for perfluoro[13c4]butanoic acid (mpfba) (40%), perfluoro[13c8]octanesulfonamide (m8fosa) (30%), 1h,1h,2h,2h-perfluoro[1,2-13c2]hexanesulfonic acid (m2-4:2fts) (182%), 1h,1h,2h,2h-perfluoro[1,2-13c2]octanesulfonic acid (m2-6:2fts) (157%), perfluoro[13c9]nonanoic acid (m9pfna) (157%), perfluoro[1,2,3,4,5,6-13c6]decanoic acid (m6pfda) (180%) and 1h,1h,2h,2h-perfluoro[1,2-13c2]decanesulfonic acid (m2-8:2fts) (362%).

L1747009-05: The Extracted Internal Standard recoveries were outside the acceptance criteria for perfluoro[13c4]butanoic acid (mpfba) (26%), perfluoro[13c8]octanesulfonamide (m8fosa) (36%), perfluoro[1,2,3,4,5,6-13c6]decanoic acid (m6pfda) (167%) and 1h,1h,2h,2h-perfluoro[1,2-13c2]decanesulfonic acid (m2-8:2fts) (313%).

WG1076397-2: The Extracted Internal Standard recoveries were outside the acceptance criteria for perfluoro[13c4]butanoic acid (mpfba) (26%), perfluoro[1,2,3,4,5,6-13c6]decanoic acid (m6pfda) (160%) and

Project Name: TOWN OF AYER
Project Number: Not Specified

Lab Number: L1747009
Report Date: 01/03/18

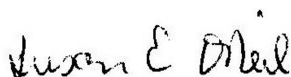
Case Narrative (continued)

1h,1h,2h,2h-perfluoro[1,2-13c2]decanesulfonic acid (m2-8:2fts) (286%).

WG1076397-3: The Extracted Internal Standard recoveries were outside the acceptance criteria for perfluoro[13c4]butanoic acid (mpfba) (36%), perfluoro[1,2,3,4,5,6-13c6]decanoic acid (m6pfda) (155%) and 1h,1h,2h,2h-perfluoro[1,2-13c2]decanesulfonic acid (m2-8:2fts) (287%).

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature:



Susan O'Neil

Title: Technical Director/Representative

Date: 01/03/18

ORGANICS

SEMIVOLATILES

Project Name: TOWN OF AYER**Lab Number:** L1747009**Project Number:** Not Specified**Report Date:** 01/03/18**SAMPLE RESULTS**

Lab ID: L1747009-01
 Client ID: MULT4-GROVE POND WTF
 Sample Location: GROVE POND

Date Collected: 12/20/17 09:35
 Date Received: 12/20/17
 Field Prep: Not Specified
 Extraction Method: EPA 537
 Extraction Date: 12/26/17 09:30

Matrix: Dw
 Analytical Method: 122,537(M)
 Analytical Date: 01/03/18 08:08
 Analyst: AJ

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Perfluorinated Alkyl Acids by Isotope Dilution - Mansfield Lab						
Perfluorobutanoic Acid (PFBA)	11.1		ng/l	1.92	--	1
Perfluoropentanoic Acid (PFPeA)	29.5		ng/l	1.92	--	1
Perfluorobutanesulfonic Acid (PFBS)	2.11		ng/l	1.92	--	1
1H,1H,2H,2H-Perfluorohexanesulfonic Acid (4:2FTS)	ND		ng/l	1.92	--	1
Perfluorohexanoic Acid (PFHxA)	21.6		ng/l	1.92	--	1
Perfluoropentanesulfonic Acid (PFPeS)	ND		ng/l	1.92	--	1
Perfluoroheptanoic Acid (PFHpA)	12.1		ng/l	1.92	--	1
Perfluorohexanesulfonic Acid (PFHxS)	11.0		ng/l	1.92	--	1
Perfluorooctanoic Acid (PFOA)	9.96		ng/l	1.92	--	1
1H,1H,2H,2H-Perfluorooctanesulfonic Acid (6:2FTS)	ND		ng/l	1.92	--	1
Perfluoroheptanesulfonic Acid (PFHpS)	ND		ng/l	1.92	--	1
Perfluorononanoic Acid (PFNA)	ND		ng/l	1.92	--	1
Perfluorooctanesulfonic Acid (PFOS)	19.2		ng/l	1.92	--	1
Perfluorodecanoic Acid (PFDA)	ND		ng/l	1.92	--	1
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2FTS)	ND		ng/l	1.92	--	1
Perfluorononanesulfonic Acid (PFNS)	ND		ng/l	1.92	--	1
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	ND		ng/l	1.92	--	1
Perfluoroundecanoic Acid (PFUnA)	ND		ng/l	1.92	--	1
Perfluorodecanesulfonic Acid (PFDS)	ND		ng/l	1.92	--	1
Perfluorooctanesulfonamide (FOSA)	ND		ng/l	1.92	--	1
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	ND		ng/l	1.92	--	1
Perfluorododecanoic Acid (PFDoA)	ND		ng/l	1.92	--	1
Perfluorotridecanoic Acid (PFTrDA)	ND		ng/l	1.92	--	1
Perfluorotetradecanoic Acid (PFTA)	ND		ng/l	1.92	--	1

Project Name: TOWN OF AYER**Lab Number:** L1747009**Project Number:** Not Specified**Report Date:** 01/03/18**SAMPLE RESULTS**

Lab ID: L1747009-01

Date Collected: 12/20/17 09:35

Client ID: MULT4-GROVE POND WTF

Date Received: 12/20/17

Sample Location: GROVE POND

Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Perfluorinated Alkyl Acids by Isotope Dilution - Mansfield Lab						

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Perfluoro[13C4]Butanoic Acid (MPFBA)	40	Q	50-150
Perfluoro[13C5]Pentanoic Acid (M5PFPEA)	112		50-150
Perfluoro[2,3,4-13C3]Butanesulfonic Acid (M3PFBS)	118		50-150
1H,1H,2H,2H-Perfluoro[1,2-13C2]Hexanesulfonic Acid (M2-4:2FTS)	167	Q	50-150
Perfluoro[1,2,3,4,6-13C5]Hexanoic Acid (M5PFHxA)	113		50-150
Perfluoro[1,2,3,4-13C4]Heptanoic Acid (M4PFHpA)	130		50-150
Perfluoro[1,2,3-13C3]Hexanesulfonic Acid (M3PFHxS)	126		50-150
Perfluoro[13C8]Octanoic Acid (M8PFOA)	132		50-150
1H,1H,2H,2H-Perfluoro[1,2-13C2]Octanesulfonic Acid (M2-6:2FTS)	145		50-150
Perfluoro[13C9]Nonanoic Acid (M9PFNA)	152	Q	50-150
Perfluoro[13C8]Octanesulfonic Acid (M8PFOS)	128		50-150
Perfluoro[1,2,3,4,5,6-13C6]Decanoic Acid (M6PFDA)	164	Q	50-150
1H,1H,2H,2H-Perfluoro[1,2-13C2]Decanesulfonic Acid (M2-8:2FTS)	309	Q	50-150
N-Deuteriomethylperfluoro-1-octanesulfonamidoacetic Acid (d3-NMeFOSAA)	111		50-150
Perfluoro[1,2,3,4,5,6,7-13C7]Undecanoic Acid (M7-PFUDA)	138		50-150
Perfluoro[13C8]Octanesulfonamide (M8FOSA)	53		50-150
N-Deuterioethylperfluoro-1-octanesulfonamidoacetic Acid (d5-NEtFOSAA)	91		50-150
Perfluoro[1,2-13C2]Dodecanoic Acid (MPFDOA)	101		50-150
Perfluoro[1,2-13C2]Tetradecanoic Acid (M2PFTEDA)	89		50-150

Project Name: TOWN OF AYER**Lab Number:** L1747009**Project Number:** Not Specified**Report Date:** 01/03/18**SAMPLE RESULTS**

Lab ID: L1747009-02
 Client ID: RW-06G-GROVE WELL #6
 Sample Location: GROVE POND

Date Collected: 12/20/17 09:55
 Date Received: 12/20/17
 Field Prep: Not Specified
 Extraction Method: EPA 537
 Extraction Date: 12/26/17 09:30

Matrix: Dw
 Analytical Method: 122,537(M)
 Analytical Date: 01/03/18 08:23
 Analyst: AJ

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Perfluorinated Alkyl Acids by Isotope Dilution - Mansfield Lab						
Perfluorobutanoic Acid (PFBA)	3.72		ng/l	1.92	--	1
Perfluoropentanoic Acid (PFPeA)	4.10		ng/l	1.92	--	1
Perfluorobutanesulfonic Acid (PFBS)	ND		ng/l	1.92	--	1
1H,1H,2H,2H-Perfluorohexanesulfonic Acid (4:2FTS)	ND		ng/l	1.92	--	1
Perfluorohexanoic Acid (PFHxA)	3.90		ng/l	1.92	--	1
Perfluoropentanesulfonic Acid (PFPeS)	ND		ng/l	1.92	--	1
Perfluoroheptanoic Acid (PFHpA)	2.34		ng/l	1.92	--	1
Perfluorohexanesulfonic Acid (PFHxS)	5.75		ng/l	1.92	--	1
Perfluorooctanoic Acid (PFOA)	6.22		ng/l	1.92	--	1
1H,1H,2H,2H-Perfluorooctanesulfonic Acid (6:2FTS)	ND		ng/l	1.92	--	1
Perfluoroheptanesulfonic Acid (PFHpS)	ND		ng/l	1.92	--	1
Perfluorononanoic Acid (PFNA)	ND		ng/l	1.92	--	1
Perfluorooctanesulfonic Acid (PFOS)	2.83		ng/l	1.92	--	1
Perfluorodecanoic Acid (PFDA)	ND		ng/l	1.92	--	1
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2FTS)	ND		ng/l	1.92	--	1
Perfluorononanesulfonic Acid (PFNS)	ND		ng/l	1.92	--	1
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	ND		ng/l	1.92	--	1
Perfluoroundecanoic Acid (PFUnA)	ND		ng/l	1.92	--	1
Perfluorodecanesulfonic Acid (PFDS)	ND		ng/l	1.92	--	1
Perfluorooctanesulfonamide (FOSA)	ND		ng/l	1.92	--	1
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	ND		ng/l	1.92	--	1
Perfluorododecanoic Acid (PFDoA)	ND		ng/l	1.92	--	1
Perfluorotridecanoic Acid (PFTrDA)	ND		ng/l	1.92	--	1
Perfluorotetradecanoic Acid (PFTA)	ND		ng/l	1.92	--	1

Project Name: TOWN OF AYER

Lab Number: L1747009

Project Number: Not Specified

Report Date: 01/03/18

SAMPLE RESULTS

Lab ID: L1747009-02

Date Collected: 12/20/17 09:55

Client ID: RW-06G-GROVE WELL #6

Date Received: 12/20/17

Sample Location: GROVE POND

Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Perfluorinated Alkyl Acids by Isotope Dilution - Mansfield Lab						

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Perfluoro[13C4]Butanoic Acid (MPFBA)	54		50-150
Perfluoro[13C5]Pentanoic Acid (M5PFPEA)	114		50-150
Perfluoro[2,3,4-13C3]Butanesulfonic Acid (M3PFBS)	122		50-150
1H,1H,2H,2H-Perfluoro[1,2-13C2]Hexanesulfonic Acid (M2-4:2FTS)	171	Q	50-150
Perfluoro[1,2,3,4,6-13C5]Hexanoic Acid (M5PFHxA)	119		50-150
Perfluoro[1,2,3,4-13C4]Heptanoic Acid (M4PFHpA)	125		50-150
Perfluoro[1,2,3-13C3]Hexanesulfonic Acid (M3PFHxS)	128		50-150
Perfluoro[13C8]Octanoic Acid (M8PFOA)	128		50-150
1H,1H,2H,2H-Perfluoro[1,2-13C2]Octanesulfonic Acid (M2-6:2FTS)	139		50-150
Perfluoro[13C9]Nonanoic Acid (M9PFNA)	131		50-150
Perfluoro[13C8]Octanesulfonic Acid (M8PFOS)	120		50-150
Perfluoro[1,2,3,4,5,6-13C6]Decanoic Acid (M6PFDA)	153	Q	50-150
1H,1H,2H,2H-Perfluoro[1,2-13C2]Decanesulfonic Acid (M2-8:2FTS)	289	Q	50-150
N-Deuteriomethylperfluoro-1-octanesulfonamidoacetic Acid (d3-NMeFOSAA)	73		50-150
Perfluoro[1,2,3,4,5,6,7-13C7]Undecanoic Acid (M7-PFUDA)	108		50-150
Perfluoro[13C8]Octanesulfonamide (M8FOSA)	25	Q	50-150
N-Deuterioethylperfluoro-1-octanesulfonamidoacetic Acid (d5-NEtFOSAA)	57		50-150
Perfluoro[1,2-13C2]Dodecanoic Acid (MPFDOA)	83		50-150
Perfluoro[1,2-13C2]Tetradecanoic Acid (M2PFTEDA)	70		50-150

Project Name: TOWN OF AYER

Lab Number: L1747009

Project Number: Not Specified

Report Date: 01/03/18

SAMPLE RESULTS

Lab ID: L1747009-03
 Client ID: RW-07G-GROVE WELL #7
 Sample Location: GROVE POND

Date Collected: 12/20/17 09:55
 Date Received: 12/20/17
 Field Prep: Not Specified
 Extraction Method: EPA 537
 Extraction Date: 12/26/17 09:30

Matrix: Dw
 Analytical Method: 122,537(M)
 Analytical Date: 01/03/18 08:38
 Analyst: AJ

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Perfluorinated Alkyl Acids by Isotope Dilution - Mansfield Lab						
Perfluorobutanoic Acid (PFBA)	12.2		ng/l	1.85	--	1
Perfluoropentanoic Acid (PFPeA)	36.3		ng/l	1.85	--	1
Perfluorobutanesulfonic Acid (PFBS)	2.03		ng/l	1.85	--	1
1H,1H,2H,2H-Perfluorohexanesulfonic Acid (4:2FTS)	ND		ng/l	1.85	--	1
Perfluorohexanoic Acid (PFHxA)	23.8		ng/l	1.85	--	1
Perfluoropentanesulfonic Acid (PFPeS)	ND		ng/l	1.85	--	1
Perfluoroheptanoic Acid (PFHpA)	13.9		ng/l	1.85	--	1
Perfluorohexanesulfonic Acid (PFHxS)	8.18		ng/l	1.85	--	1
Perfluorooctanoic Acid (PFOA)	10.0		ng/l	1.85	--	1
1H,1H,2H,2H-Perfluorooctanesulfonic Acid (6:2FTS)	ND		ng/l	1.85	--	1
Perfluoroheptanesulfonic Acid (PFHpS)	ND		ng/l	1.85	--	1
Perfluorononanoic Acid (PFNA)	ND		ng/l	1.85	--	1
Perfluorooctanesulfonic Acid (PFOS)	12.4		ng/l	1.85	--	1
Perfluorodecanoic Acid (PFDA)	ND		ng/l	1.85	--	1
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2FTS)	ND		ng/l	1.85	--	1
Perfluorononanesulfonic Acid (PFNS)	ND		ng/l	1.85	--	1
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	ND		ng/l	1.85	--	1
Perfluoroundecanoic Acid (PFUnA)	ND		ng/l	1.85	--	1
Perfluorodecanesulfonic Acid (PFDS)	ND		ng/l	1.85	--	1
Perfluorooctanesulfonamide (FOSA)	ND		ng/l	1.85	--	1
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	ND		ng/l	1.85	--	1
Perfluorododecanoic Acid (PFDoA)	ND		ng/l	1.85	--	1
Perfluorotridecanoic Acid (PFTrDA)	ND		ng/l	1.85	--	1
Perfluorotetradecanoic Acid (PFTA)	ND		ng/l	1.85	--	1

Project Name: TOWN OF AYER

Lab Number: L1747009

Project Number: Not Specified

Report Date: 01/03/18

SAMPLE RESULTS

Lab ID: L1747009-03

Date Collected: 12/20/17 09:55

Client ID: RW-07G-GROVE WELL #7

Date Received: 12/20/17

Sample Location: GROVE POND

Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Perfluorinated Alkyl Acids by Isotope Dilution - Mansfield Lab						

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Perfluoro[13C4]Butanoic Acid (MPFBA)	50		50-150
Perfluoro[13C5]Pentanoic Acid (M5PFPEA)	116		50-150
Perfluoro[2,3,4-13C3]Butanesulfonic Acid (M3PFBS)	123		50-150
1H,1H,2H,2H-Perfluoro[1,2-13C2]Hexanesulfonic Acid (M2-4:2FTS)	172	Q	50-150
Perfluoro[1,2,3,4,6-13C5]Hexanoic Acid (M5PFHxA)	126		50-150
Perfluoro[1,2,3,4-13C4]Heptanoic Acid (M4PFHpA)	127		50-150
Perfluoro[1,2,3-13C3]Hexanesulfonic Acid (M3PFHxS)	127		50-150
Perfluoro[13C8]Octanoic Acid (M8PFOA)	133		50-150
1H,1H,2H,2H-Perfluoro[1,2-13C2]Octanesulfonic Acid (M2-6:2FTS)	137		50-150
Perfluoro[13C9]Nonanoic Acid (M9PFNA)	133		50-150
Perfluoro[13C8]Octanesulfonic Acid (M8PFOS)	112		50-150
Perfluoro[1,2,3,4,5,6-13C6]Decanoic Acid (M6PFDA)	133		50-150
1H,1H,2H,2H-Perfluoro[1,2-13C2]Decanesulfonic Acid (M2-8:2FTS)	259	Q	50-150
N-Deuteriomethylperfluoro-1-octanesulfonamidoacetic Acid (d3-NMeFOSAA)	78		50-150
Perfluoro[1,2,3,4,5,6,7-13C7]Undecanoic Acid (M7-PFUDA)	86		50-150
Perfluoro[13C8]Octanesulfonamide (M8FOSA)	51		50-150
N-Deuterioethylperfluoro-1-octanesulfonamidoacetic Acid (d5-NEtFOSAA)	57		50-150
Perfluoro[1,2-13C2]Dodecanoic Acid (MPFDOA)	70		50-150
Perfluoro[1,2-13C2]Tetradecanoic Acid (M2PFTEDA)	64		50-150

Project Name: TOWN OF AYER**Lab Number:** L1747009**Project Number:** Not Specified**Report Date:** 01/03/18**SAMPLE RESULTS**

Lab ID: L1747009-04
 Client ID: RW08G-GROVE WELL #8
 Sample Location: GROVE POND

Date Collected: 12/20/17 09:55
 Date Received: 12/20/17
 Field Prep: Not Specified
 Extraction Method: EPA 537
 Extraction Date: 12/26/17 09:30

Matrix: Dw
 Analytical Method: 122,537(M)
 Analytical Date: 01/03/18 08:53
 Analyst: AJ

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Perfluorinated Alkyl Acids by Isotope Dilution - Mansfield Lab						
Perfluorobutanoic Acid (PFBA)	29.5		ng/l	1.92	--	1
Perfluoropentanoic Acid (PFPeA)	98.4		ng/l	1.92	--	1
Perfluorobutanesulfonic Acid (PFBS)	3.13		ng/l	1.92	--	1
1H,1H,2H,2H-Perfluorohexanesulfonic Acid (4:2FTS)	ND		ng/l	1.92	--	1
Perfluorohexanoic Acid (PFHxA)	71.7		ng/l	1.92	--	1
Perfluoropentanesulfonic Acid (PFPeS)	2.07		ng/l	1.92	--	1
Perfluoroheptanoic Acid (PFHpA)	40.1		ng/l	1.92	--	1
Perfluorohexanesulfonic Acid (PFHxS)	29.3		ng/l	1.92	--	1
Perfluorooctanoic Acid (PFOA)	20.6		ng/l	1.92	--	1
1H,1H,2H,2H-Perfluorooctanesulfonic Acid (6:2FTS)	ND		ng/l	1.92	--	1
Perfluoroheptanesulfonic Acid (PFHpS)	ND		ng/l	1.92	--	1
Perfluorononanoic Acid (PFNA)	ND		ng/l	1.92	--	1
Perfluorooctanesulfonic Acid (PFOS)	69.0		ng/l	1.92	--	1
Perfluorodecanoic Acid (PFDA)	ND		ng/l	1.92	--	1
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2FTS)	ND		ng/l	1.92	--	1
Perfluorononanesulfonic Acid (PFNS)	ND		ng/l	1.92	--	1
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	ND		ng/l	1.92	--	1
Perfluoroundecanoic Acid (PFUnA)	ND		ng/l	1.92	--	1
Perfluorodecanesulfonic Acid (PFDS)	ND		ng/l	1.92	--	1
Perfluorooctanesulfonamide (FOSA)	ND		ng/l	1.92	--	1
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	ND		ng/l	1.92	--	1
Perfluorododecanoic Acid (PFDoA)	ND		ng/l	1.92	--	1
Perfluorotridecanoic Acid (PFTrDA)	ND		ng/l	1.92	--	1
Perfluorotetradecanoic Acid (PFTA)	ND		ng/l	1.92	--	1

Project Name: TOWN OF AYER**Lab Number:** L1747009**Project Number:** Not Specified**Report Date:** 01/03/18**SAMPLE RESULTS****Lab ID:** L1747009-04**Date Collected:** 12/20/17 09:55**Client ID:** RW08G-GROVE WELL #8**Date Received:** 12/20/17**Sample Location:** GROVE POND**Field Prep:** Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Perfluorinated Alkyl Acids by Isotope Dilution - Mansfield Lab						

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Perfluoro[13C4]Butanoic Acid (MPFBA)	40	Q	50-150
Perfluoro[13C5]Pentanoic Acid (M5PFPEA)	122		50-150
Perfluoro[2,3,4-13C3]Butanesulfonic Acid (M3PFBS)	133		50-150
1H,1H,2H,2H-Perfluoro[1,2-13C2]Hexanesulfonic Acid (M2-4:2FTS)	182	Q	50-150
Perfluoro[1,2,3,4,6-13C5]Hexanoic Acid (M5PFHxA)	121		50-150
Perfluoro[1,2,3,4-13C4]Heptanoic Acid (M4PFHpA)	131		50-150
Perfluoro[1,2,3-13C3]Hexanesulfonic Acid (M3PFHxS)	139		50-150
Perfluoro[13C8]Octanoic Acid (M8PFOA)	143		50-150
1H,1H,2H,2H-Perfluoro[1,2-13C2]Octanesulfonic Acid (M2-6:2FTS)	157	Q	50-150
Perfluoro[13C9]Nonanoic Acid (M9PFNA)	157	Q	50-150
Perfluoro[13C8]Octanesulfonic Acid (M8PFOS)	141		50-150
Perfluoro[1,2,3,4,5,6-13C6]Decanoic Acid (M6PFDA)	180	Q	50-150
1H,1H,2H,2H-Perfluoro[1,2-13C2]Decanesulfonic Acid (M2-8:2FTS)	362	Q	50-150
N-Deuteriomethylperfluoro-1-octanesulfonamidoacetic Acid (d3-NMeFOSAA)	129		50-150
Perfluoro[1,2,3,4,5,6,7-13C7]Undecanoic Acid (M7-PFUDA)	143		50-150
Perfluoro[13C8]Octanesulfonamide (M8FOSA)	30	Q	50-150
N-Deuterioethylperfluoro-1-octanesulfonamidoacetic Acid (d5-NEtFOSAA)	101		50-150
Perfluoro[1,2-13C2]Dodecanoic Acid (MPFDOA)	125		50-150
Perfluoro[1,2-13C2]Tetradecanoic Acid (M2PFTEDA)	113		50-150

Project Name: TOWN OF AYER**Lab Number:** L1747009**Project Number:** Not Specified**Report Date:** 01/03/18**SAMPLE RESULTS**

Lab ID: L1747009-05
 Client ID: FIELD BLANK
 Sample Location: GROVE POND

Date Collected: 12/20/17 10:00
 Date Received: 12/20/17
 Field Prep: Not Specified
 Extraction Method: EPA 537
 Extraction Date: 12/26/17 09:30

Matrix: Dw
 Analytical Method: 122,537(M)
 Analytical Date: 01/03/18 07:53
 Analyst: AJ

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Perfluorinated Alkyl Acids by Isotope Dilution - Mansfield Lab						
Perfluorobutanoic Acid (PFBA)	ND		ng/l	1.78	--	1
Perfluoropentanoic Acid (PFPeA)	ND		ng/l	1.78	--	1
Perfluorobutanesulfonic Acid (PFBS)	ND		ng/l	1.78	--	1
1H,1H,2H,2H-Perfluorohexanesulfonic Acid (4:2FTS)	ND		ng/l	1.78	--	1
Perfluorohexanoic Acid (PFHxA)	ND		ng/l	1.78	--	1
Perfluoropentanesulfonic Acid (PFPeS)	ND		ng/l	1.78	--	1
Perfluoroheptanoic Acid (PFHpA)	ND		ng/l	1.78	--	1
Perfluorohexanesulfonic Acid (PFHxS)	ND		ng/l	1.78	--	1
Perfluorooctanoic Acid (PFOA)	ND		ng/l	1.78	--	1
1H,1H,2H,2H-Perfluorooctanesulfonic Acid (6:2FTS)	ND		ng/l	1.78	--	1
Perfluoroheptanesulfonic Acid (PFHpS)	ND		ng/l	1.78	--	1
Perfluorononanoic Acid (PFNA)	ND		ng/l	1.78	--	1
Perfluorooctanesulfonic Acid (PFOS)	ND		ng/l	1.78	--	1
Perfluorodecanoic Acid (PFDA)	ND		ng/l	1.78	--	1
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2FTS)	ND		ng/l	1.78	--	1
Perfluorononanesulfonic Acid (PFNS)	ND		ng/l	1.78	--	1
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	ND		ng/l	1.78	--	1
Perfluoroundecanoic Acid (PFUnA)	ND		ng/l	1.78	--	1
Perfluorodecanesulfonic Acid (PFDS)	ND		ng/l	1.78	--	1
Perfluorooctanesulfonamide (FOSA)	ND		ng/l	1.78	--	1
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	ND		ng/l	1.78	--	1
Perfluorododecanoic Acid (PFDoA)	ND		ng/l	1.78	--	1
Perfluorotridecanoic Acid (PFTrDA)	ND		ng/l	1.78	--	1
Perfluorotetradecanoic Acid (PFTA)	ND		ng/l	1.78	--	1

Project Name: TOWN OF AYER

Lab Number: L1747009

Project Number: Not Specified

Report Date: 01/03/18

SAMPLE RESULTS

Lab ID: L1747009-05
 Client ID: FIELD BLANK
 Sample Location: GROVE POND

Date Collected: 12/20/17 10:00
 Date Received: 12/20/17
 Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Perfluorinated Alkyl Acids by Isotope Dilution - Mansfield Lab						

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Perfluoro[13C4]Butanoic Acid (MPFBA)	26	Q	50-150
Perfluoro[13C5]Pentanoic Acid (M5PFPEA)	118		50-150
Perfluoro[2,3,4-13C3]Butanesulfonic Acid (M3PFBS)	130		50-150
1H,1H,2H,2H-Perfluoro[1,2-13C2]Hexanesulfonic Acid (M2-4:2FTS)	136		50-150
Perfluoro[1,2,3,4,6-13C5]Hexanoic Acid (M5PFHxA)	118		50-150
Perfluoro[1,2,3,4-13C4]Heptanoic Acid (M4PFHpA)	117		50-150
Perfluoro[1,2,3-13C3]Hexanesulfonic Acid (M3PFHxS)	127		50-150
Perfluoro[13C8]Octanoic Acid (M8PFOA)	128		50-150
1H,1H,2H,2H-Perfluoro[1,2-13C2]Octanesulfonic Acid (M2-6:2FTS)	105		50-150
Perfluoro[13C9]Nonanoic Acid (M9PFNA)	140		50-150
Perfluoro[13C8]Octanesulfonic Acid (M8PFOS)	124		50-150
Perfluoro[1,2,3,4,5,6-13C6]Decanoic Acid (M6PFDA)	167	Q	50-150
1H,1H,2H,2H-Perfluoro[1,2-13C2]Decanesulfonic Acid (M2-8:2FTS)	313	Q	50-150
N-Deuteriomethylperfluoro-1-octanesulfonamidoacetic Acid (d3-NMeFOSAA)	121		50-150
Perfluoro[1,2,3,4,5,6,7-13C7]Undecanoic Acid (M7-PFUDA)	145		50-150
Perfluoro[13C8]Octanesulfonamide (M8FOSA)	36	Q	50-150
N-Deuterioethylperfluoro-1-octanesulfonamidoacetic Acid (d5-NEtFOSAA)	91		50-150
Perfluoro[1,2-13C2]Dodecanoic Acid (MPFDOA)	119		50-150
Perfluoro[1,2-13C2]Tetradecanoic Acid (M2PFTEDA)	99		50-150

Project Name: TOWN OF AYER

Lab Number: L1747009

Project Number: Not Specified

Report Date: 01/03/18

Method Blank Analysis Batch Quality Control

Analytical Method: 122,537(M)
 Analytical Date: 01/03/18 07:08
 Analyst: AJ

Extraction Method: EPA 537
 Extraction Date: 12/26/17 09:30

Parameter	Result	Qualifier	Units	RL	MDL
Perfluorinated Alkyl Acids by Isotope Dilution - Mansfield Lab for sample(s): 01-05 Batch: WG1076397-1					
Perfluorobutanoic Acid (PFBA)	ND		ng/l	2.00	--
Perfluoropentanoic Acid (PFPeA)	ND		ng/l	2.00	--
Perfluorobutanesulfonic Acid (PFBS)	ND		ng/l	2.00	--
1H,1H,2H,2H-Perfluorohexanesulfonic Acid (4:2FTS)	ND		ng/l	2.00	--
Perfluorohexanoic Acid (PFHxA)	ND		ng/l	2.00	--
Perfluoropentanesulfonic Acid (PFPeS)	ND		ng/l	2.00	--
Perfluoroheptanoic Acid (PFHpA)	ND		ng/l	2.00	--
Perfluorohexanesulfonic Acid (PFHxS)	ND		ng/l	2.00	--
Perfluorooctanoic Acid (PFOA)	ND		ng/l	2.00	--
1H,1H,2H,2H-Perfluorooctanesulfonic Acid (6:2FTS)	ND		ng/l	2.00	--
Perfluoroheptanesulfonic Acid (PFHpS)	ND		ng/l	2.00	--
Perfluorononanoic Acid (PFNA)	ND		ng/l	2.00	--
Perfluorooctanesulfonic Acid (PFOS)	ND		ng/l	2.00	--
Perfluorodecanoic Acid (PFDA)	ND		ng/l	2.00	--
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2FTS)	ND		ng/l	2.00	--
Perfluorononanesulfonic Acid (PFNS)	ND		ng/l	2.00	--
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	ND		ng/l	2.00	--
Perfluoroundecanoic Acid (PFUnA)	ND		ng/l	2.00	--
Perfluorodecanesulfonic Acid (PFDS)	ND		ng/l	2.00	--
Perfluorooctanesulfonamide (FOSA)	ND		ng/l	2.00	--
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	ND		ng/l	2.00	--
Perfluorododecanoic Acid (PFDoA)	ND		ng/l	2.00	--
Perfluorotridecanoic Acid (PFTrDA)	ND		ng/l	2.00	--
Perfluorotetradecanoic Acid (PFTA)	ND		ng/l	2.00	--

Project Name: TOWN OF AYER

Lab Number: L1747009

Project Number: Not Specified

Report Date: 01/03/18

Method Blank Analysis Batch Quality Control

Analytical Method: 122,537(M)
 Analytical Date: 01/03/18 07:08
 Analyst: AJ

Extraction Method: EPA 537
 Extraction Date: 12/26/17 09:30

Parameter	Result	Qualifier	Units	RL	MDL
Perfluorinated Alkyl Acids by Isotope Dilution - Mansfield Lab for sample(s): 01-05 Batch: WG1076397-1					

Surrogate	%Recovery	Qualifier	Acceptance Criteria
Perfluoro[13C4]Butanoic Acid (MPFBA)	53		50-150
Perfluoro[13C5]Pentanoic Acid (M5PFPEA)	122		50-150
Perfluoro[2,3,4-13C3]Butanesulfonic Acid (M3PFBS)	129		50-150
1H,1H,2H,2H-Perfluoro[1,2-13C2]Hexanesulfonic Acid (M2-4:2FTS)	138		50-150
Perfluoro[1,2,3,4,6-13C5]Hexanoic Acid (M5PFHxA)	118		50-150
Perfluoro[1,2,3,4-13C4]Heptanoic Acid (M4PFHpA)	116		50-150
Perfluoro[1,2,3-13C3]Hexanesulfonic Acid (M3PFHxS)	121		50-150
Perfluoro[13C8]Octanoic Acid (M8PFOA)	123		50-150
1H,1H,2H,2H-Perfluoro[1,2-13C2]Octanesulfonic Acid (M2-6:2FTS)	99		50-150
Perfluoro[13C9]Nonanoic Acid (M9PFNA)	114		50-150
Perfluoro[13C8]Octanesulfonic Acid (M8PFOS)	122		50-150
Perfluoro[1,2,3,4,5,6-13C6]Decanoic Acid (M6PFDA)	122		50-150
1H,1H,2H,2H-Perfluoro[1,2-13C2]Decanesulfonic Acid (M2-8:2FTS)	144		50-150
N-Deuteriomethylperfluoro-1-octanesulfonamidoacetic Acid (d3-NMeFOSAA)	94		50-150
Perfluoro[1,2,3,4,5,6,7-13C7]Undecanoic Acid (M7-PFUDA)	134		50-150
Perfluoro[13C8]Octanesulfonamide (M8FOSA)	56		50-150
N-Deuterioethylperfluoro-1-octanesulfonamidoacetic Acid (d5-NEtFOSAA)	89		50-150
Perfluoro[1,2-13C2]Dodecanoic Acid (MPFDOA)	114		50-150
Perfluoro[1,2-13C2]Tetradecanoic Acid (M2PFTEDA)	114		50-150

Lab Control Sample Analysis **Batch Quality Control**

Project Name: TOWN OF AYER

Project Number: Not Specified

Lab Number: L1747009

Report Date: 01/03/18

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Perfluorinated Alkyl Acids by Isotope Dilution - Mansfield Lab Associated sample(s): 01-05 Batch: WG1076397-2 WG1076397-3								
Perfluorobutanoic Acid (PFBA)	100		97		50-150	3		30
Perfluoropentanoic Acid (PFPeA)	102		96		50-150	6		30
Perfluorobutanesulfonic Acid (PFBS)	108		108		50-150	0		30
1H,1H,2H,2H-Perfluorohexanesulfonic Acid (4:2FTS)	93		98		50-150	5		30
Perfluorohexanoic Acid (PFHxA)	98		101		50-150	3		30
Perfluoropentanesulfonic Acid (PFPeS)	102		106		50-150	4		30
Perfluoroheptanoic Acid (PFHpA)	92		87		50-150	6		30
Perfluorohexanesulfonic Acid (PFHxS)	113		115		50-150	2		30
Perfluorooctanoic Acid (PFOA)	94		92		50-150	2		30
1H,1H,2H,2H-Perfluorooctanesulfonic Acid (6:2FTS)	99		108		50-150	9		30
Perfluoroheptanesulfonic Acid (PFHpS)	94		96		50-150	2		30
Perfluorononanoic Acid (PFNA)	92		95		50-150	3		30
Perfluorooctanesulfonic Acid (PFOS)	91		92		50-150	1		30
Perfluorodecanoic Acid (PFDA)	102		95		50-150	7		30
1H,1H,2H,2H-Perfluorodecanesulfonic Acid (8:2FTS)	103		86		50-150	18		30
Perfluorononanesulfonic Acid (PFNS)	70		72		50-150	3		30
N-Methyl Perfluorooctanesulfonamidoacetic Acid (NMeFOSAA)	96		98		50-150	2		30
Perfluoroundecanoic Acid (PFUnA)	101		87		50-150	15		30
Perfluorodecanesulfonic Acid (PFDS)	96		91		50-150	5		30
Perfluorooctanesulfonamide (FOSA)	88		88		50-150	0		30
N-Ethyl Perfluorooctanesulfonamidoacetic Acid (NEtFOSAA)	96		84		50-150	13		30
Perfluorododecanoic Acid (PFDoA)	90		81		50-150	11		30

Lab Control Sample Analysis **Batch Quality Control**

Project Name: TOWN OF AYER

Lab Number: L1747009

Project Number: Not Specified

Report Date: 01/03/18

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Perfluorinated Alkyl Acids by Isotope Dilution - Mansfield Lab Associated sample(s): 01-05 Batch: WG1076397-2 WG1076397-3								
Perfluorotridecanoic Acid (PFTrDA)	84		78		50-150	7		30
Perfluorotetradecanoic Acid (PFTA)	93		99		50-150	6		30

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria
Perfluoro[13C4]Butanoic Acid (MPFBA)	26	Q	36	Q	50-150
Perfluoro[13C5]Pentanoic Acid (M5PFPEA)	109		119		50-150
Perfluoro[2,3,4-13C3]Butanesulfonic Acid (M3PFBS)	119		129		50-150
1H,1H,2H,2H-Perfluoro[1,2-13C2]Hexanesulfonic Acid (M2-4:2FTS)	127		130		50-150
Perfluoro[1,2,3,4,6-13C5]Hexanoic Acid (M5PFHxA)	111		117		50-150
Perfluoro[1,2,3,4-13C4]Heptanoic Acid (M4PFHpA)	106		111		50-150
Perfluoro[1,2,3-13C3]Hexanesulfonic Acid (M3PFHxS)	116		120		50-150
Perfluoro[13C8]Octanoic Acid (M8PFOA)	114		114		50-150
1H,1H,2H,2H-Perfluoro[1,2-13C2]Octanesulfonic Acid (M2-6:2FTS)	108		110		50-150
Perfluoro[13C9]Nonanoic Acid (M9PFNA)	129		134		50-150
Perfluoro[13C8]Octanesulfonic Acid (M8PFOS)	117		120		50-150
Perfluoro[1,2,3,4,5,6-13C6]Decanoic Acid (M6PFDA)	160	Q	155	Q	50-150
1H,1H,2H,2H-Perfluoro[1,2-13C2]Decanesulfonic Acid (M2-8:2FTS)	286	Q	287	Q	50-150
N-Deuteriomethylperfluoro-1-octanesulfonamidoacetic Acid (d3-NMeFOSAA)	104		104		50-150
Perfluoro[1,2,3,4,5,6,7-13C7]Undecanoic Acid (M7-PFUDA)	117		126		50-150
Perfluoro[13C8]Octanesulfonamide (M8FOSA)	75		78		50-150
N-Deuterioethylperfluoro-1-octanesulfonamidoacetic Acid (d5-NEtFOSAA)	89		102		50-150
Perfluoro[1,2-13C2]Dodecanoic Acid (MPFDOA)	112		116		50-150
Perfluoro[1,2-13C2]Tetradecanoic Acid (M2PFTEDA)	119		100		50-150

Project Name: TOWN OF AYER**Lab Number:** L1747009**Project Number:** Not Specified**Report Date:** 01/03/18**Sample Receipt and Container Information**

Were project specific reporting limits specified?

YES

Cooler Information

Cooler	Custody Seal
A	Absent

Container Information

Container ID	Container Type	Cooler	Initial pH	Final pH	Temp deg C	Pres	Seal	Frozen Date/Time	Analysis(*)
L1747009-01A	3 Plastic Trizma/1 Plastic/1 H2O+Trizma	A	NA		2.3	Y	Absent		A2-537-ISOTOPE(14)
L1747009-01B	3 Plastic Trizma/1 Plastic/1 H2O+Trizma	A	NA		2.3	Y	Absent		A2-537-ISOTOPE(14)
L1747009-01C	3 Plastic Trizma/1 Plastic/1 H2O+Trizma	A	NA		2.3	Y	Absent		A2-537-ISOTOPE(14)
L1747009-02A	3 Plastic Trizma/1 Plastic/1 H2O+Trizma	A	NA		2.3	Y	Absent		A2-537-ISOTOPE(14)
L1747009-02B	3 Plastic Trizma/1 Plastic/1 H2O+Trizma	A	NA		2.3	Y	Absent		A2-537-ISOTOPE(14)
L1747009-02C	3 Plastic Trizma/1 Plastic/1 H2O+Trizma	A	NA		2.3	Y	Absent		A2-537-ISOTOPE(14)
L1747009-03A	3 Plastic Trizma/1 Plastic/1 H2O+Trizma	A	NA		2.3	Y	Absent		A2-537-ISOTOPE(14)
L1747009-03B	3 Plastic Trizma/1 Plastic/1 H2O+Trizma	A	NA		2.3	Y	Absent		A2-537-ISOTOPE(14)
L1747009-03C	3 Plastic Trizma/1 Plastic/1 H2O+Trizma	A	NA		2.3	Y	Absent		A2-537-ISOTOPE(14)
L1747009-04A	3 Plastic Trizma/1 Plastic/1 H2O+Trizma	A	NA		2.3	Y	Absent		A2-537-ISOTOPE(14)
L1747009-04B	3 Plastic Trizma/1 Plastic/1 H2O+Trizma	A	NA		2.3	Y	Absent		A2-537-ISOTOPE(14)
L1747009-04C	3 Plastic Trizma/1 Plastic/1 H2O+Trizma	A	NA		2.3	Y	Absent		A2-537-ISOTOPE(14)
L1747009-05A	3 Plastic Trizma/1 Plastic/1 H2O+Trizma	A	NA		2.3	Y	Absent		A2-537-ISOTOPE(14)

Project Name: TOWN OF AYER
Project Number: Not Specified

Lab Number: L1747009
Report Date: 01/03/18

GLOSSARY

Acronyms

EDL	- Estimated Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The EDL includes any adjustments from dilutions, concentrations or moisture content, where applicable. The use of EDLs is specific to the analysis of PAHs using Solid-Phase Microextraction (SPME).
EPA	- Environmental Protection Agency.
LCS	- Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LCSD	- Laboratory Control Sample Duplicate: Refer to LCS.
LFB	- Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
MDL	- Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
MS	- Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available.
MSD	- Matrix Spike Sample Duplicate: Refer to MS.
NA	- Not Applicable.
NC	- Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.
NDPA/DPA	- N-Nitrosodiphenylamine/Diphenylamine.
NI	- Not Ignitable.
NP	- Non-Plastic: Term is utilized for the analysis of Atterberg Limits in soil.
RL	- Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
RPD	- Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.
SRM	- Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.
STLP	- Semi-dynamic Tank Leaching Procedure per EPA Method 1315.
TIC	- Tentatively Identified Compound: A compound that has been identified to be present and is not part of the target compound list (TCL) for the method and/or program. All TICs are qualitatively identified and reported as estimated concentrations.

Footnotes

- 1 - The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Final pH: As it pertains to Sample Receipt & Container Information section of the report, Final pH reflects pH of container determined after adjustment at the laboratory, if applicable. If no adjustment required, value reflects Initial pH.

Frozen Date/Time: With respect to Volatile Organics in soil, Frozen Date/Time reflects the date/time at which associated Reagent Water-preserved vials were initially frozen. Note: If frozen date/time is beyond 48 hours from sample collection, value will be reflected in 'bold'.

Initial pH: As it pertains to Sample Receipt & Container Information section of the report, Initial pH reflects pH of container determined upon receipt, if applicable.

Total: With respect to Organic analyses, a 'Total' result is defined as the summation of results for individual isomers or Aroclors. If a 'Total' result is requested, the results of its individual components will also be reported. This is applicable to 'Total' results for methods 8260, 8081 and 8082.

Data Qualifiers

- A** - Spectra identified as "Aldol Condensation Product".
- B** - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For MCP-related

Report Format: Data Usability Report



Project Name: TOWN OF AYER**Lab Number:** L1747009**Project Number:** Not Specified**Report Date:** 01/03/18**Data Qualifiers**

projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit. For NJ-related projects (excluding Air), flag only applies to associated field samples that have detectable concentrations of the analyte, which was detected above the reporting limit in the associated method blank or above five times the reporting limit for common lab contaminants (Phthalates, Acetone, Methylene Chloride, 2-Butanone).

- C** - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.
- D** - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.
- E** - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.
- G** - The concentration may be biased high due to matrix interferences (i.e. co-elution) with non-target compound(s). The result should be considered estimated.
- H** - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.
- I** - The lower value for the two columns has been reported due to obvious interference.
- M** - Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.
- NJ** - Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.
- P** - The RPD between the results for the two columns exceeds the method-specified criteria.
- Q** - The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)
- R** - Analytical results are from sample re-analysis.
- RE** - Analytical results are from sample re-extraction.
- S** - Analytical results are from modified screening analysis.
- J** - Estimated value. This represents an estimated concentration for Tentatively Identified Compounds (TICs).
- ND** - Not detected at the reporting limit (RL) for the sample.

Project Name: TOWN OF AYER
Project Number: Not Specified

Lab Number: L1747009
Report Date: 01/03/18

REFERENCES

- 122 Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS). EPA Method 537, EPA/600/R-08/092. Version 1.1, September 2009.

LIMITATION OF LIABILITIES

Alpha Analytical performs services with reasonable care and diligence normal to the analytical testing laboratory industry. In the event of an error, the sole and exclusive responsibility of Alpha Analytical shall be to re-perform the work at its own expense. In no event shall Alpha Analytical be held liable for any incidental, consequential or special damages, including but not limited to, damages in any way connected with the use of, interpretation of, information or analysis provided by Alpha Analytical.

We strongly urge our clients to comply with EPA protocol regarding sample volume, preservation, cooling, containers, sampling procedures, holding time and splitting of samples in the field.



Alpha Analytical, Inc.

ID No.:17873

Facility: **Company-wide**

Revision 10

Department: **Quality Assurance**

Published Date: 1/16/2017 11:00:05 AM

Title: **Certificate/Approval Program Summary**

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Certification Information

The following analytes are not included in our Primary NELAP Scope of Accreditation:

Westborough Facility**EPA 624:** m/p-xylene, o-xylene**EPA 8260C:** NPW: 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene, Azobenzene; SCM: Iodomethane (methyl iodide), Methyl methacrylate, 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene.**EPA 8270D:** NPW: Dimethylnaphthalene, 1,4-Diphenylhydrazine; SCM: Dimethylnaphthalene, 1,4-Diphenylhydrazine.**EPA 300:** DW: Bromide**EPA 6860:** NPW and SCM: Perchlorate**EPA 9010:** NPW and SCM: Amenable Cyanide Distillation**EPA 9012B:** NPW: Total Cyanide**EPA 9050A:** NPW: Specific Conductance**SM3500:** NPW: Ferrous Iron**SM4500:** NPW: Amenable Cyanide, Dissolved Oxygen; SCM: Total Phosphorus, TKN, NO₂, NO₃.**SM5310C:** DW: Dissolved Organic Carbon**Mansfield Facility****SM 2540D:** TSS**EPA 3005A** NPW**EPA 8082A:** NPW: PCB: 1, 5, 31, 87, 101, 110, 141, 151, 153, 180, 183, 187.**EPA TO-15:** Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene, 3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 1-Methylnaphthalene.**Biological Tissue Matrix:** EPA 3050B

The following analytes are included in our Massachusetts DEP Scope of Accreditation

Westborough Facility:**Drinking Water****EPA 300.0:** Nitrate-N, Fluoride, Sulfate; **EPA 353.2:** Nitrate-N, Nitrite-N; **SM4500NO3-F:** Nitrate-N, Nitrite-N; **SM4500F-C, SM4500CN-CE, EPA 180.1, SM2130B, SM4500CI-D, SM2320B, SM2540C, SM4500H-B****EPA 332:** Perchlorate; **EPA 524.2:** THMs and VOCs; **EPA 504.1:** EDB, DBCP.**Microbiology:** **SM9215B; SM9223-P/A, SM9223B-Colilert-QT, SM9222D.****Non-Potable Water****SM4500H,B, EPA 120.1, SM2510B, SM2540C, SM2320B, SM4500CL-E, SM4500F-BC, SM4500NH3-BH, EPA 350.1:** Ammonia-N, **LACHAT 10-107-06-1-B:** Ammonia-N, **SM4500NO3-F, EPA 353.2:** Nitrate-N, **EPA 351.1, SM4500P-E, SM4500P-B, E, SM4500SO4-E, SM5220D, EPA 410.4, SM5210B, SM5310C, SM4500CL-D, EPA 1664, EPA 420.1, SM4500-CN-CE, SM2540D.****EPA 624:** Volatile Halocarbons & Aromatics,**EPA 608:** Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs**EPA 625:** SVOC (Acid/Base/Neutral Extractables), **EPA 600/4-81-045:** PCB-Oil.**Microbiology:** **SM9223B-Colilert-QT; Enterolert-QT, SM9221E.****Mansfield Facility:****Drinking Water****EPA 200.7:** Ba, Be, Cd, Cr, Cu, Ni, Na, Ca. **EPA 200.8:** Sb, As, Ba, Be, Cd, Cr, Cu, Pb, Ni, Se, TL. **EPA 245.1 Hg.****Non-Potable Water****EPA 200.7:** Al, Sb, As, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Sr, TL, Ti, V, Zn.**EPA 200.8:** Al, Sb, As, Be, Cd, Cr, Cu, Pb, Mn, Ni, Se, Ag, TL, Zn.**EPA 245.1 Hg.****SM2340B**

For a complete listing of analytes and methods, please contact your Alpha Project Manager.

